# LECTURES

## ON

# ANATOMY.

# LECTURES

ON

# A N A T O M Y:

## INTERSPERSED WITH PRACTICAL REMARKS.

*VOL. IV.*

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# PREFACE.

In offering this my Fourth and last Volume to the Public, I complete the series of my Anatomical Lectures; and trust that I have fulfilled the intentions which I proposed in the Preface to my First Volume.

From the very flattering manner in which the preceding Three Volumes have been reviewed by the periodical press, and from the readiness with which the pupils, not only of my own, but of other classes, have adopted my general classification and mode of anatomical instruction as their guide, I cannot but indulge a sanguine expectation, that the Work may be found useful, not only to the Student, but to the Profession at large.

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# LECTURES ON ANATOMY.

## PART VII.

## DESCRIPTIVE ANATOMY OF THE ARTERIES.

# LECTURE XXVI.

## DESCRIPTIVE ANATOMY OF THE ARTERIES.

THE principle which I have adopted in the following description of the arteries, I have taken from the example of my friend Mr. Joshua Brookes, as it possesses considerable advantage in assisting the memory of the student.

It is to consider the two principal arteries arising from the heart, as arterial trunks. The branches immediately given off from the systemic trunk, are named arteries, and numbered in the order of their succession. The branches from arteries, are named rami; branches from rami, ramuli; branches from ramuli, ramusculi; branches from ramusculi, ramifications; and their ultimate terminations, distributions.

Before we commence a description of the anatomy of the arteries, it will be necessary again to take a view of the precise situation of the heart within the thorax, in order that its position in relation to the large arteries arising from it may be clearly understood.

The heart is placed obliquely within the chest; its base being opposite to the fourth dorsal vertebra, partly resting upon the diaphragm; while its apex is directed obliquely downwards, forwards, and to the left, towards the interspace of the fifth and sixth ribs. With regard to the ventricles and auricles,—those of the right side are placed most anteriorly, and form the acute edge; while the left auricle and ventricle form the obtuse edge, and posterior part of the heart.

The PULMONARY ARTERIAL TRUNK—already described with the organization of the lungs (Vide Vol. III. p. 186), is the first vessel seen in the natural position of the heart; arising from the upper and anterior part of the base of the right ventricle, where it conceals the origin of the aorta.

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The AORTA—the main trunk of the systemic distribution, arises from the base of the left ventricle, and immediately takes its course obliquely upwards, and to the right; and, like the pulmonary, appears to be directed, so as to convey the current of the blood in the direction of the contractile forces of their respective ventricles.

The origin of the aorta is opposite to the fourth dorsal vertebra, its termination at the junction of the fourth with the fifth lumbar vertebra; in this extent it takes a curved course, and is divided into an ascending, transverse, and descending portion.

The ASCENDING AORTA—commences from the upper and fore part of the left ventricle, rather to the left of the fourth dorsal vertebra, and extends upwards and obliquely to the right, in the direction of the long axis of the heart, as high as the upper edge of the third dorsal vertebra, where it terminates in the commencement of the arch. In this course it is first covered by the pulmonary artery, which arises immediately in front of it; above which is a small space, still within the pericardium; on emerging from the pericardium, it takes its course between the pulmonary artery on the left, and the superior cava on the right; while the right branch of the pulmonary artery is behind it. This portion of the aorta is visible on opening the cavity of the chest, having nothing in front of it, excepting the contents of the anterior mediastinum, which separates it from the second bone of the sternum. The aorta is connected with the heart in the following manner:—Externally, by a continuation of the pericardium; secondly, by its fibrous coat, which is not a continuation of the muscular fibres of the heart, but commences abruptly by three semilunar folds, which are attached to the fleshy fibres of the ventricle; thirdly, by the internal lining membrane of the ventricle, which is continued into the ascending aorta, forming at its commencement three semilunar valves. The opening of the aorta from the ventricle is of a triangular figure, and contracted, but almost immediately enlarges, forming three

pouches corresponding to each valve, which are termed the sinuses of Morgagni. These pouches are not produced by the pressure of the column of regurgitating blood, but are natural formations tending to facilitate the propulsion of the blood in the systole of the heart, being surrounded by the muscular fibres of the ventricle itself, which partly overlap them where they are exterior to the semilunar valves.

The only branches which are given off by the ascending aorta are, the coronary or cardiac arteries, whose office it is to supply the heart itself with blood. They are two in number, and are distinguished from each other by their course.

(1.) *Arteria coronaria dextra vel anterior* — is sent off from the ascending aorta, immediately above the free edge of the semilunar valve, which faces somewhat diagonally towards the right side. It immediately after its origin takes its course downwards and forwards, in front of that portion of the aorta which is seen anteriorly before it is crossed by the pulmonary arterial trunk ; it then passes in a tortuous manner in the fissure between the right auricle and ventricle, where it divides itself into three principal rami, —a superior, an inferior, and a posterior.

(A.) *Ramus superior*—passes in a course between the auricle and ventricle, along the base of the latter, around which it passes until it meets a similar branch from the left coronary artery. In this course it distributes several ramifications, some of which pass upward and backward to the right auricle, and others downward and forward to the parietes of the right ventricle.

(B.) *Ramus inferior*—is directed forwards and downwards, along the thin edge of the right ventricle, as far as the apex of the heart, where it anastomoses with the left coronary artery, dividing in its passage into several anterior and posterior ramifications, to supply the corresponding surfaces of the ventricles and septum cordis.

(C.) *Ramus posterior* — passes backwards and downwards to supply the back part of the right ventricle and

septum cordis, and anastomoses, like the inferior branch, at the apex.

(2.) *Arteria coronaria sinistra vel posterior*—is smaller than the right, it arises immediately above the floating edge of the most anterior of the semilunar valves ; but, like the right, is placed rather transversely, being inclined to the left, to take its course between the pulmonary artery and left auricle, by the apex of which it is partly concealed. It soon divides into two rami, a superior and an inferior.

(A.) *Ramus superior*—takes its course backwards, in the groove between the left auricle and ventricle, sending off numerous ramifications superiorly and inferiorly to supply each of these cavities, and terminates by anastomosing with the superior branch of the right coronary artery. By this anastomosis, the arteries form a complete line of separation between the auricles and ventricles.

(B.) *Ramus inferior*—descending along the septum cordis anteriorly, sends numerous ramifications into the substance of both ventricles, as well as to the fleshy partition between them ; and terminates at the apex, by freely anastomosing with the right coronary artery.

The ultimate termination of the coronary arteries may be considered to be in the fleshy fasciculi of the heart ; but they also frequently anastomose with the phrenic, internal mammary, and bronchial vessels.

At the third dorsal vertebra, where it has already been said that the ascending aorta terminates, there the *arch* of that vessel begins,—which has now to be described.

The ARCH OF THE AORTA—extends from the right of the upper part of the third dorsal, to the left of the same bone ; in its course it first passes upwards, backwards, and to the left, as high as the second dorsal vertebra, which it crosses, being placed in front of the trachea ; where, having gained its vertex, it is continued downwards and backwards, between the vertebræ and left lung, to arrive at the left side of the third dorsal vertebra, where the arch is completed. It is to

be observed, therefore, that the arch is not placed transversely, but is directed from before to behind, from right to left, and from above to below. To facilitate a more accurate description of the relative position of the arch of the aorta, it may be divided into its right anterior, its middle, and its left posterior thirds.

The *right anterior third of the arch*—is that portion between the ascending aorta and the arteria innominata.

The *middle third*—where it crosses the second dorsal vertebra, resting upon the trachea just above its division; and

The *left posterior third*—where it reaches from the left of the second to the lower edge of the third dorsal vertebra.

Each of these parts has some important anatomical points connected with it.

The right anterior third, instead of continuing in the direction of the ascending aorta, namely, in that of the axis of the heart, is directed backwards and to the left; it passes in front of the right bronchus, is placed between the trachea and descending vena cava, and has connected with it the left vena innominata, which is just above it. It is about opposite to the junction of the cartilage of the second rib with the first two bones of the sternum.

The middle third, as has been before said, rests upon the trachea, opposite the second dorsal vertebra. It may be comprehended between the arteria innominata and the left subclavian; the left vena innominata runs immediately above it; and just where the middle becomes connected with the descending portion of the arch, the ductus arteriosus connects it with the pulmonary arterial trunk.

The inferior third, as it lies upon the left side of the bodies of the second and third dorsal vertebræ, which are frequently indented by the pressure of this vessel, has, to the right, the œsophagus, and more posteriorly, the thoracic duct; while immediately behind it, is the recurrent laryngeal branch of the par vagum—the par vagum being placed in front. The concavity of the arch of the aorta is directed downwards and to the left; and within its parabolic curve it

encloses several important organs: first is seen the pulmo-
nary trunk, and its two arteries; behind them, the left
bronchus, the œsophagus, the thoracic duct, and the left
pneumogastric nerve, with its recurrent branch, besides some
small dark coloured glands surrounding the bronchi.

. The arteries given off from the convexity of the middle
third of the arch of the aorta are usually three in number,
and are destined to supply the neck, head, upper extremities,
and part of the chest.

These are denominated the arteria innominata, the left
carotid, and the left subclavian arteries.

(3.) *Arteria innominata*—arises from the junction of the
anterior with the middle third of the arch, being, therefore,
from the most anterior portion of the aorta, and opposite to
the junction of the cartilage of the second rib to the ster-
num; from thence it extends upwards, obliquely, to the
right, as high as the sterno clavicular articulation, where it
divides into the right common carotid and right subclavian
vessels.

In this course the arteria innominata is bounded in *front*
by the sternum, sterno hyoideus and sterno thyroideus mus-
cles, and vena innominata; *behind*, by the trachea and longus
colli muscle; the latter, however, is separated from the
vessel by a considerable quantity of cellular membrane.

The arteria innominata, from its commencement to its
division, does not usually give off any branches; but some-
times a small vessel arises from it, which passes upwards, in
front of the trachea, to be distributed to the thyroid gland,
and has been described as the middle thyroid artery.

The origin of the left common carotid artery should next
be examined, as it arises within the thorax from the arch of
the aorta; and is not placed under the same circumstances
as the right until it has reached the left sterno clavicular
articulation; the point corresponding with the commencement
of the right common carotid.

(4.) The *arteria carotidis communis sinistra*—arises from
the arch of the aorta, on a plane posterior to the arteria

innominata, and forms very nearly a right angle with the arch, passing upwards, with a slight obliquity to the left, as high as the sterno clavicular articulation, where it is placed under precisely the same circumstances as the right carotid. By the extent of its thoracic portion it is longer than the right, but is somewhat smaller; and, in this situation, is bounded in front by the sternum, by the remains of the thymus gland, and crossed by the vena innominata: it runs upwards on the left side of the trachea, to which it is nearly parallel, but partly covers it, as well as the thoracic duct and œsophagus; then emerging from the chest, it corresponds to the right vessel: from hence, therefore, one description answers for both arteries.

(4.) The *arteriæ carotides communes*—from the sterno clavicular articulations, diverge, as they pass upwards and backwards, to reach the upper edge of the thyroid cartilage, where they each divide into an external and an internal corotid ramus. This division most frequently takes place on a plane with the lower edge of the third cervical vertebra. In this course they are placed under different circumstances as regards their relative position with neighbouring parts, being at their commencement deeply seated, covered by the platysma myoides, sterno cleido mastoideus, sterno hyoideus, sterno thyroideus, and omo hyoideus muscles; but when they reach as high as the cricoid cartilage they become superficial, in consequence of the direction the sterno cleido mastoidei muscles take upwards and backwards to gain their insertion; so that from this point to their termination, the common carotid arteries are lying in a hollow between the inner edge of the sterno cleido mastoidei and larynx, and are only covered by the platysma myoides, fascia of the neck, and superficial veins and nerves.

At their commencement, the common carotids correspond posteriorly to the bodies of the cervical vertebræ; but above, to their transverse processes: they first rest upon the longus colli muscle, and as they ascend, upon the rectus capitis anticus major; they each cross in front of the inferior thy-

roideal ramulus, the recurrent branch of the par vagum and the sympathetic nerve. The common carotid arteries are enclosed in a sheath of fascia, and are accompanied by the internal jugular vein, which is on their outer side, and by the pneumogastric nerve, which runs between the artery and vein. Exterior to the sheath, and in front, the descending branch of the lingual nerve may be seen, being placed to its outer or mastoid side above, and to its inner or tracheal side below; forming, in this course, junctions with the cervical nerves.

The common carotid arteries, as has been before mentioned, diverge, as they pass from below upwards, to an extent depending more or less upon the size of the trachea and larynx; they do not give off any branches prior to their division into an external and internal carotid, opposite to the upper edge of the thyroid cartilage.

I shall now, contrary to the plan usually followed by anatomical writers, describe that portion of the left subclavian artery which is placed within the cavity of the chest, instead of first tracing the numerous ramuli of the external and internal carotids, as I shall then have completed the account of the origin of the vessels from the arch of the aorta

(5.) *Arteria subclavia sinistra*—like the left common carotid, arises from the arch of the aorta, within the thorax, but posterior to it, being separated from the arch just at the junction of the middle with the descending third; from this point it ascends, nearly vertically, as high as the inner edge of the first rib, where it is placed under the same circumstances as the right subclavian; and from thence a common description will serve for both vessels.

While this vessel is within the chest it is very deeply seated, resting upon the longus colli muscle and inferior cervical ganglion of the sympathetic nerve, running upwards parallel with the œsophagus; it is, anteriorly, covered by the left lung and pleura, the par vagum, the left common carotid artery, the jugular vein and vena innominata, the thoracic duct, the sterno cleido mastoideus, sterno hyoideus,

sterno thyroideus muscles; and as to bones, by the first rib, clavicle, and sternum. This portion of the left subclavian artery, which renders it so much longer than the right, is, however, the smaller; and is much more deeply seated than it, the arteria innominata, or the left common carotid.

The common carotid arteries have already been described as passing from their origin to the upper part of the thyroid cartilage, before they divide; and in this course they do not give off any branches, but terminate by dividing into an external and an internal carotid ramus, which are destined to supply the head, face, and neck.

(A.) *Ramus carotidis externus* — supplies the face and exterior of the head. It extends from the upper edge of the thyroid cartilage to the cervix of the lower jaw, where it terminates by dividing into the temporal and internal maxillary ramuli, within the substance of the parotid gland. In its course it is at first anterior, and to the inner side of the internal carotid, and runs parallel to it, in this situation being comparatively superficial; it then dips under the lingual nerve, the stylo hyoideus muscle, and at the posterior belly of the digastricus again becomes superficial, here as below being only covered by the platysma myoides; it then passes outwards and backwards, just behind the angle of the lower jaw, where it buries itself in the substance of the parotid gland, to divide into the temporal and internal maxillary ramuli. In thus passing to its termination it does not take a straight course, but presents a convexity, looking forwards and upwards toward the pharynx and tonsil, and a concavity backward, to the sterno cleido mastoideus.

It has opposed to it on its inner side the pharyngeal plexus of nerves, the stylo glossus, stylo pharyngeus muscles, and glosso pharyngeal nerve; and above, a portion of the parotid gland; all of which tend to separate the external from the internal carotid artery.

The ramuli which this ramus distributes may be divided into four distinct sets, from the direction of their course, viz.:—anteriorly, posteriorly, internally, and ascending.

The anterior ramuli of the external carotid, which are given off from the convexity of its curve, may now be examined: they are three in number,—the superior thyroideal, the lingual, and the facial.

(a.) *Ramulus thyroideus superior vel descendens*—is the first vessel sent off by the external carotid, and usually immediately below the cornu of the os hyoides; it extends to the thyroid gland, in which it ramifies, taking however a circuitous course, first running upwards and inwards, and then forming its course downwards to the thyroid gland. The trunk of this vessel is only covered by the platysma myoides, being accompanied by the laryngeal nerve, which is posterior to it; while above, but separated from it by the cornu of the os hyoides, is the lingual ramulus and nerve.

The superior thyroideal ramulus is destined to supply parts between the os hyoides and thyroid cartilage, the larynx and the thyroid; for which purpose, it sends off three principal ramusculi—ramusculus hyoideus, ramusculus laryngeus, and ramusculus thyroideus.

(α.) *Ramusculus hyoideus*—ascends from the trunk of the thyroid ramulus, and usually takes its course along the under edge of the os hyoides, anastomosing with a similar vessel of the opposite side, sending ramifications upwards to anastomose with the lingual ramulus, and to supply the thyro hyoideus, omo, and sterno hyoidei muscles, and the thyro hyoid ligament.

A superficial ramification· is usually separated from the hyoideal, which runs downwards to supply the glands of the neck, sterno cleido mastoideus, and platysma myoides.

(β.) *Ramusculus laryngeus*—proceeds towards the upper part of the larynx, behind the thyro hyoideus muscle, accompanied by the laryngeal branch of the par vagum. This little ramusculus enters the larynx, sometimes above the thyroid cartilage, piercing the broad ligament; at others · between the thyroid and cricoid, penetrating the crico thyroid ligament; and less frequently, passes through a foramen of the thyroid cartilage: when it has gained the interior, it

divides into numerous distributions to supply the muscles
and mucous membrane of the larynx and epiglottis, anasto-
mosing with those of the opposite side. A small ramifica-
tion should be particularly observed, which takes its course
downwards and inwards over the thyroid cartilage to gain
the crico thyroid ligament, where it forms an anastomosis
with a similar ramification of the opposite side. This vessel
should be particularly remembered in opening the larynx
between these two cartilages.

(γ.) *Ramusculus thyroideus*—seems a continuation of
the original ramulus, and takes its course behind the sterno
thyroideus muscle to gain the thyroid gland, where it divides
pretty generally into three ramifications : one, running along
the upper edge of the gland to anastomose with its fellow;
a second, passing behind the gland, between it and the
trachea; and a third, taking its course downwards, along the
outer edge of the gland, to anastomose with the inferior
thyroideal ramulus—but all plentifully supplying the paren-
chyma of the organ.

Although the lingual ramulus is the next given off by the
external carotid, it is better first to dissect the fascial and
its ramifications, as the lingual may be more readily dis-
sected afterwards.

(b.) *Ramulus maxillaris, vel facialis externus*—is usually
given off by the external carotid, behind the digastricus and
stylo hyoideus muscles; it immediately takes a tortuous
course forwards and inwards, towards the submaxillary
gland, behind which it passes (the gland usually separating
this artery from its accompanying vein); it then runs for-
wards upon the mylo hyoideus muscle, from the anterior
edge of which it dips down to pass around the horizontal
portion of the lower jaw to gain the face, just anterior to
the edge of the masseter muscle, being covered by the
platysma myoides, and some fibres of the depressor anguli
oris; here it becomes embedded in a considerable quantity
of fat, lying on the buccinator muscle. It then winds under
the zygomatici, and levator labii superioris alæque nasi

muscles; and running up by the side of the nose, terminates at the inner canthus of the eye, anastomosing with the nasal ramusculus of the ophthalmic of the internal carotid.

In this course it gives off numerous ramusculi, which may be divided into two sets,—those which are given off below the jaw, and those which are distributed to the face.

Those which are given off below the jaw, are two principal ramusculi,—the inferior or ascending palatine, and the submental, besides some small ramifications to the muscles and glands.

(*a.*) *Ramusculus palati inferior, vel ascendens*—is given off almost immediately, at the separation of the facial from the external carotid; it then passes upwards, in front of the stylo pharyngeus and behind the stylo glossus muscle, upon the side of the pharynx, and distributes itself to these muscles, to the tongue, the tonsils, and the eustachian tube; and is lost by supplying the soft palate and uvula, anastomosing with the superior or descending palatine ramusculus of the internal maxillary ramulus.

*Muscular ramifications*—are sent off below the jaw to the stylo hyoideus, stylo pharyngeus, and stylo glossus muscles.

(*β.*) *Ramusculus tonsilaris*—near the insertion of the stylo glossus, is often separated from the facial ramulus; and penetrating the pharynx, supplies the tonsil of its own side.

(*γ.*) *Ramusculi glandulares*—are also distributed from this vessel to the submaxillary gland, and neighbouring absorbent glands.

(*δ.*) *Ramusculus submentalis*—is separated from the facial artery while it is covered by the submaxillary gland, and proceeds forwards, above the anterior belly of the digastricus, towards the symphisis of the lower jaw, being placed superior to the lower edge of the horizontal portion, resting upon the mylo hyoideus, and surrounded by a chain of absorbent glands. This ramusculus not unfrequently supplies the place of the sublingual of the lingual ramulus. It distributes ramifications downwards and in front

of the digastricus, to anastomose with a corresponding ramification from the opposite side; sending some downward, to anastomose with the hyoideal ramusculi of the lingual ramulus; and some upward upon the chin, to anastomose with the dental of the internal maxillary, and inferior labial of the facial—supplying at the same time various muscles.

After having distributed these vessels below the jaw, the ramulus facialis mounts upon the face, and distributes the following ramusculi—first externally.

(ε.) *Ramusculi masseteres*—which supply the masseter muscle; and some take their course with the parotid duct, and supply the gland, anastomosing with the ramusculi of the temporal.

Ramifications are also distributed to the buccinator, to the platysma myoides, and to the depressor labii inferiores; anastomosing with the submental ramusculi, and the inferior dental as it passes out of the anterior maxillary foramen.

(ζ.) *Ramusculus labialis inferior*—takes a very tortuous course towards the commissure of the mouth, and supplies both the muscles and mucous membrane of the under lip; anastomosing with the corresponding ramusculus of the opposite side, and also with the inferior dental and submental ramusculi.

(η.) *Ramusculus labialis superior vel coronarius*—is given off from the ramulus facialis, above the commissure of the mouth, and gains by a very tortuous course the upper lip, into the muscles and mucous membrane of which it plentifully distributes itself, anastomosing in the centre of the lip with the opposite corresponding ramusculus, from which small ramifications mount vertically towards the partition of the nose, where they expand themselves, supplying the depressor muscles of the lip and alæ of the nose.

The coronary ramusculi are, however, very variable, both as to situation and size. One of them very frequently extends to the commissure of the mouth, and there dividing, supplies the place of both.

The facial ramulus is still continued upwards by the side

of the nose, under the levator labii superioris alæque nasi, and in its course sends off the

(9.) *Ramusculus lateralis nasi*—which distributes itself upon the side of the nose, supplying the compressor nasis, anastomosing with its fellow and descending ramification from the forehead.

The facial ramulus terminates by giving off the

(*i.*) *Ramusculus angularis*—which mounts to the inner canthus of the eye, between the two origins of the levator labii superioris alæque nasi, where it anastomoses with the infra orbitar ramusculus of the internal maxillary, sending ramifications in this situation to the orbicularis palbebrarum; it then reaches the lachrymal sac, which it supplies, anastomosing here with the nasal ramusculus of the ophthalmic of the internal carotid, and terminates by ramifications to the orbicular muscle of the upper eye-lid, and by anastomosing with the supra orbitar ramusculus of the internal carotid ramus.

(*c.*) *Ramulus lingualis.*—This vessel is not unfrequently given off from the external carotid, in a common trunk with the facial, but more frequently below it, and between it and the superior thyroideal. It is rather more deeply seated, and takes its course forwards, upwards and inwards, above the os hyoides, to gain the tongue. In the first part of its course it is accompanied by the lingual nerve, which is rather above it; and until it gains the posterior edge of the hyo glossus muscle, it is only covered by the skin, platysma myoides, and fascia; it then passes above the hyo glossus muscle, by which it is separated from the lingual nerve, which takes its course upon the inferior surface of the muscle, at the anterior edge of which they again meet, and between the hyo glossus and genio hyo glossus terminate in the tongue.

In this course, the lingual ramulus gives off the four following ramusculi.

(*a.*) *Ramusculus hyoideus*—is given off before the lingual ramus gains the upper surface of the hyo glossus muscle;

this ramusculus passes along the superior surface of the os hyoides, distributing itself to the muscles of the base of the tongue, and of the lower jaw.

(β.) *Ramusculus dorsalis linguæ*—is given off from the lingual while upon the upper surface of the hyo-glossus; it takes its course upwards and outwards, towards the base of the tongue; and passing between the hyo-glossus and lingualis muscles, it gains the dorsum of the tongue, where it anastomoses with the opposite ramusculus, sending ramifications backwards to supply the fauces, tonsil, and epiglottis, anastomosing with the ascending palatine ramusculus of the facial ramulus.

(γ.) *Ramusculus sublingualis*—is frequently substituted by the submental ramulus of the facial; when given off by the lingual it arises just at the anterior edge of the hyoglossus muscle, and takes its course forwards between the genio-hyoideus muscles, and the sublingual gland,—supplying both; it then penetrates the mylo-hyoideus, and is lost upon the chin, anastomosing with the submental, the inferior dental, and the inferior coronary ramusculi.

(δ.) *Ramusculus raninus*—seems to be a continuation of the lingual ramus, and is continued forwards to the apex of the tongue, between the lingualis and genio-hyo-glossus muscles, distributing a ramification to them, and also to the hyo-glossus and stylo-glossus muscles, as well as to the frænum, by the side of which it runs, being there only covered by the mucous membrane of the tongue, and accompanied by a vein and a branch of the lingual nerve.

The ramuli given off from the external carotid artery, posteriorly, are the occipital and posterior aural.

(d.) *Ramulus occipitalis*—is usually separated from the external carotid, opposite to the origin of the facial or lingual ramulus, but is smaller than either of them; it extends to the posterior part of the occipital bone, where it terminates by numerous anastomosing vessels. In taking this course, it passes backwards under the posterior belly of the digastricus, sterno cleido mastoideus, trachelo mastoideus

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muscles, and the lingual nerve, which completely hooks around it; it crosses anterior to the internal carotid artery, jugular vein, pneumo-gastric, and spinal accessory nerves, and then rests upon the rectus capitis lateralis, being placed between the transverse process of the atlas and the occiput, being here covered by the splenius, and complexus, the latter of which muscles it frequently perforates to gain the occiput, immediately above the attachment of the obliquus superior and rectus capitis posticus major. The first ramusculi sent off ʻfrom the occipital ramulus, supply the digastric and stylo-hyoideus muscles.

Ramuli also pass downward along the anterior edge of the sterno cleido mastoideus, to supply the superficial cervical glands, and terminate by anastomosing with the superior thyroideal ramusculi.

While the occipital ramulus is crossing the carotid artery and internal jugular vein, it sends ʻa ramusculus meningeus upwards on the vein which passes through the foramen lacerum basis cranii, to supply the dura mater. It also sends the ramusculus auricularis to the lobe of the ear; and when behind the trachelo mastoideus, and splenius, it supplies them both with blood. When it gains the occiput, it sends a ramification transversely above the insertion of the obliquus, and rectus superior muscles, to anastomose with the corresponding vessel of the opposite side, forming an arch, with its convexity upwards and concavity downwards; from the latter, several ramifications pass downward to supply the recti and obliqui.

A deep ramification passes to anastomose with the vertebral artery; and a long descending ramification passes upon the semispinalis colli and under surface of the complexus, to anastomose with the ramus·cervicalis profundus of the subclavian artery. From the convexity, numerous ramifications pass upward on the occiput to anastomose with the temporal and posterior aural, one of which passes through the mastoid foramen to supply the dura mater.

(e.) *Ramulus auricularis posterior, vel stylo-mastoideus—*

is given off in the substance of the parotid gland, above the
posterior belly of the digastric muscle, and in front of the
styloid process of the temporal bone; it takes its course
backwards, towards the mastoid process of the temporal
bone, between it and the ear; it ascends upon the bone,
anastomosing with the temporal and occipital ramusculi. In
this course it sends off small ramifications to the parotid
gland, the digastric, sterno cleido mastoideus, and trapezius
muscles.

(α.) *Ramusculus stylo mastoideus*—passes into the stylo
mastoid foramen, and also divides into numerous smaller
ramifications to supply the ear.

(β.) A ramusculus passes to the tympanum, which runs
around the bony circumference of the membrana tympani;
and anastomosing with a branch from the internal maxillary,
they send off distributions to supply the membrane.

Ramifications also supply the mastoid cells, the cavity of
the tympanum, and the canal of fallopius.

The posterior aural, after having sent off the stylo mastoid
ramusculus, distributes ramifications behind the ear to sup-
ply the posterior part of the concha, and backwards to
ramify on the splenius muscle and occipital bone, anasto-
mosing with the occipital ramulus; and its terminating
ramifications pass upward upon the aponeurosis of the
temporal muscle to anastomose anteriorly with the temporal,
and posteriorly with the occipital ramusculi.

The ramus which is given off from the inner side of the
external carotid artery, is the

(*f.*) *Ramulus pharyngis ascendens, vel inferior*—which is
a very small vessel, and so deeply situated as to be with
difficulty exposed. It arises from the inner side of the
external carotid, on a level with the facial ramulus, but
posterior to it, and ascends on the rectus capitis anticus
muscle, between the external and internal carotids. At
first it is placed behind the stylo pharyngeus muscle, and
then behind the outer edge of the constrictors of the pha-
rynx. In this course it sends distributions inwards to supply

the pharynx, sending a distinct vessel to each constrictor muscle,—the superior one supplying also, by small *outer* ramifications, the stylo pharyngeus muscle, and the eustachian tube,—and *anterior* ones to the soft palate, and internal parts of the nostrils. The trunk of the ascending pharyngeal ramulus still passes upwards, between the internal carotid and jugular vein, to enter the foramen lacerum basis cranii, and terminate on the dura mater.

(α) *Ramusculus meningeus.*—Some small ramusculi also enter the cranium through the anterior lacerated, and anterior condyloid foramina, to supply the bones of the skull and dura mater. The par vagum, and sympathetic nerves, are also supplied with blood by these ramusculi.

The two ramuli by which the external carotid terminates, are—

(g.) *Ramulus temporalis superficialis.*—This ramulus, which seems to be a continuation of the external carotid, passes upwards between the neck of the lower jaw and the auditory canal, being covered by the parotid gland; it then arises above the zygomatic arch, passing under the anterior auricular muscle, becomes superficial, and ramifies upon the aponeurosis of the temporal muscle. In this course it sends off the following ramusculi.

(α.) *Ramusculus parotideus*—to supply the parotid gland.

(β.) *Ramusculus articularis*—to the temporo maxillary articulation, which passes to the posterior part of the meatus auditorius, and sending small ramifications through the glenoid fissure into the cavity of the tympanum, anastomoses with the posterior auricular artery, and supplies the membrana tympani, and the muscles of the malleus.

(γ.) The *ramusculus transversus facialis*—is most frequently given off by the temporal, although sometimes from the external carotid itself. It takes its course with, and above the parotid duct, across the masseter muscle, being surrounded by filaments of the portio dura nerve; having reached the anterior edge of the masseter muscle, it divides into numerous ramifications to anastomose with the

alveolar, infra orbitar, and with the coronary distributions
of the facial ramus.

(δ.) The *ramusculus profundus temporalis*—is usually
sent off below the zygomatic arch, then rises above it to
penetrate the aponeurosis of the temporal muscle, to be
distributed to it, anastomosing with the deep temporal
ramification of the internal maxillary ramulus of the external
carotid. The temporal ramulus, immediately after it has
given off the last described ramusculus upon the aponeu-
rosis of the temporal muscle, terminates by dividing into
an anterior and posterior ramusculus.

(ε.) *Ramusculus temporalis anterior*—takes its course
upwards and forwards, towards the upper part of the orbi-
cularis palbebrarum, to be distributed to it, the integuments
and muscles of the forehead, anastomosing with the supra
orbitalis, and frontal ramifications of the ramulus ophthal-
micus of the internal carotid ramus.

(ζ.) *Ramusculus temporalis posterior*—curves upwards
and backwards, distributing numerous ramifications to the
scalp and occipito frontalis muscle, anastomosing with the
posterior auris, and ramulus occipitalis of the external
carotid.

(h.) *Ramulus maxillaris internus*—the second ramulus
forming the termination of the external carotid, is destined
to supply the deep-seated parts of the face, and extends from
immediately behind the neck of the lower jaw to the spheno-
maxillary fossa. In this course it is tortuous, but passes
with sufficient regularity of direction as to admit of being
described in four distinct portions. The first is horizontal,
passing forwards nearly at right angles from the external
carotid, between the neck of the lower jaw and internal
lateral ligament of the temporo maxillary articulation. While
in this situation, two ramusculi are sent off by the internal
maxillary ramulus,—one passing upwards to the dura mater,
the other downwards to supply the teeth of the lower jaw.

(α.) *Ramusculus meningeus medius vel spheno-spinalis*—
arises from the upper part of the internal maxillary ramulus,

and passes vertically upwards towards the foramen spi-
nosum of the sphenoid bone, being first placed to the outer
side of the internal lateral ligament of the lower jaw; it
then passes anterior to the circumflexus palati muscle and
the eustachian tube, to enter the skull by the above-named
foramen.   In this course, exterior to the skull, it sends
ramifications to the pterygoideus externus muscle, along the
eustachian tube to the ear, and to the circumflexus and tensor
palati muscles; some few ramifications passing into the for-
amen lacerum basis cranii anterius, to supply the dura mater.
The course of the middle meningeal artery within the skull,
may be traced from the spinous process of the sphenoid bone
to the anterior edge of the squamous portion of the temporal;
from whence it passes along a groove on the anterior and
inferior angle of the parietal bone; from which point it
proceeds in the course of the coronal suture, to terminate
by a ramification which anastomoses with a corresponding
one from the opposite side on the vertex of the skull.
Immediately after its entrance at the foramen spinosum, it
sends some small ramifications forward into the orbit by the
foramen lacerum orbitale, to anastomose with the ophthalmic
ramulus. Small ramifications pass backward to the aqueduct
of fallopius, from whence other small distributions pass into
the cavity of the tympanum; while larger ramifications pass
in an anterior, middle, and posterior direction, to terminate
in the supply of the dura mater, and bones of the skull.

   (β.) *Ramusculus maxillaris inferior vel dentalis*—passes
downwards and slightly forwards, between the neck of the
lower jaw and internal lateral ligament, to enter the poste-
rior maxillary foramen, accompanied with its corresponding
nerve. In this course it gives off ramifications to the supe-
rior constrictor of the pharynx, buccinator, internal pterygoid,
and mylo-hyoideus muscles. After entering the dental for-
amen, it takes its course in the mental canal of the body of
the lower jaw, and gives off a ramification to each of the
alveoli to supply the teeth; and the ramusculus terminates
by two ramifications, — one passing out at the anterior

maxillary foramen, anastomosing with ramifications of the
facial ramusculi about the chin ; the other continues within
the bone, passing forwards to supply the incisor teeth.

The second portion of the internal maxillary ramulus, is
directed obliquely upwards and forwards, and is placed
between the two pterygoid muscles ; being bounded above,
by the insertion of the temporal muscle, and on the inner
side, by the buccinator; in this situation, it supplies the
capsular ligament of the temporo-maxillary articulation.
The masseter, buccinator, pterygoid, and temporal muscles,
sending ramusculi to each, which are named according to
their respective distributions, viz. :—(γ.) *ramusculi capsu-
lares ;* (δ.) *ramusculi masseteres ;* (ε.) *ramusculi buccales ;*
(ζ.) *ramusculi pterygoidei ;* (η.) *ramusculi temporales pro-
fundi posteriores.*

The third portion of the internal maxillary ramulus, re-
sumes the horizontal direction of the first portion, passing
forwards in the zygomatic fossa, parallel with the zygoma.
In this course it sends upwards ramusculi of considerable
size, the (ϑ.) *ramusculi temporales profundi anteriores,*
which ramify upon the temporal muscle, in the anterior
region of the temporal fossa, anastomosing on the outer brim
of the orbit with ramifications of the ophthalmic ramulus.
This third portion next gives off the (ι.) *ramusculus dentalis
vel maxillaris superior,* a ramusculus of considerable size,
arising near the tuberosity of the superior maxillary bone ;
it passes forwards in a serpentine direction around the body
of the bone approaching the alveolar processes, to perforate
their small opening and supply the roots of the teeth ; it
also sends ramifications through the body of the bone, to
supply the mucous membrane of the antrum, and expends it-
self by anastomosing with the infra orbitar ramusculus above,
and in the supply of the gums below. The third ramusculus
in this course of the internal maxillary ramulus is (κ.) *ra-
musculus infra orbitalis,* passes forwards over the tuberosity
of the superior maxillary bone, through the foramen lacerum
orbitale inferius, to enter the infra orbitar canal, the whole

length of which it traverses, passing out at the termination of this canal in the infra orbitar foramen. The ramusculus then gains the face immediately under the orbit, anastomosing freely with the facial and temporal ramuli. While within the orbit, it sends off some ramifications to the fat and muscles, and others to supply the mucous membrane within the antrum.

The fourth and last portion of the internal maxillary ramulus takes its direction downwards, forwards and inwards, between the two origins of the external pterygoid muscle, and gains the spheno maxillary fossa, where it terminates by dividing into the following ramusculi.

(λ.) *Ramusculus palatinus superior vel descendens.*— This vessel passes vertically downwards into the pterygomaxillary fissure, and enters the posterior palatine canal, which terminates in a foramen at the posterior part of the palate bone; the vessel passes from thence, forwards, between the membrane and the vault of the palate; giving off numerous ramifications to the mucous membrane and its follicles, and terminates by a small ramification which passes upwards through the foramen incisivum into the nose, to anastomose with the lateral nasal ramusculus.

(μ.) *Ramusculus nasalis vel spheno palatinus*—is separated from the inner side of the internal maxillary ramulus, and enters the nose through the spheno palatine foramen, at the posterior part of the upper meatus; it divides into numerous ramifications to supply the pituitary membrane of the septum, and superior turbinated bones; and some pass into the anterior and superior ethmoidal cells, anastomosing within the nose with the ascending ramusculus of the superior palatine. From the spheno maxillary fossa there are two other ramifications found, which usually arise from one or the other of the ramusculi just described; although by some anatomists they are attributed to the internal maxillary itself.

One of these, and which most frequently is from the superior palatine ramusculus, takes its course backwards

through the pterygoid canal with the vidian nerve, and is lost in ramifications on the eustachian tube and upper part of the pharynx.

The second, and still smaller ramification, is usually given off by the spheno-palatine, and is termed the superior pharyngeal ramification, which takes its course backwards, from the entrance of the spheno-palatine foramen into the nose, to be distributed to the upper part of the pharynx and eustachian tube, anastomosing freely with the ascending or inferior pharyngeal ramification of the external carotid ramus.

(B.) *Ramus carotidis internus vel cerebralis*—so called because it supplies the parts within the cranium. This ramus commences from the bifurcation of the common carotid, on a plane with the lower part of the third cervical vertebra, and opposite the superior part of the thyroid cartilage of the larynx; from this point it ascends through the cervical region to the base of the skull, where it enters the foramen caroticum of the temporal bone, taking the tortuous course of this canal: and, lastly, it terminates within the interior of the skull by perforating the dura mater, just above the anterior clinoid processes of the sphenoid bone, where it sends off its cerebral branches.

To facilitate the history of this ramus, it may be described in three portions: its first or cervical portion, extends from the transverse process of the third cervical vertebra to the foramen caroticum of the temporal bone. In this course its direction is not straight, but forms several flexuosities, which vary in different subjects. At its origin, this portion is directed outwards, towards the side of the neck; it then ascends inwards and a little forwards, becoming deeper and more tortuous as it approaches the entrance of the carotid canal. In this extent it does not give off any ramuli; it has in front of it, the external carotid with its ramuli, the styloid process and its muscles, the digastric muscle, the parotid gland, the facial, lingual, and glosso-pharyngeal nerves; behind it, the m. rectus capitis anticus major, the par vagum,

and ganglion of the sympathetic nerve; external, and rather posterior to it, the external jugular vein, and lingual nerve; the latter, as it passes outwards from the anterior condyloid foramen, is at first in front of the vein and behind the artery; then, as it passes downwards and forwards, external to these vessels, and at the anterior part of the neck, it becomes superficial to both external and internal carotids. Internally, this division of the carotid has the pharynx on its inner side, more closely connected to it by cellular membrane below than at its superior part; while the tonsils are internal, more anterior, and connected to the ramus only by loose cellular membrane.

The middle division of the internal carotid, enters the carotid canal posterior to the eustachian tube and levator palati muscle; at first ascending, then it turns obliquely forwards, then upwards and inwards, and lastly, it ascends, inclined a little backwards, gaining the foramen lacerum anterius. In this course, the artery lies at first anterior and external to the tympanum and labyrinth; it then turns obliquely forwards, parallel with the entrance of the eustachian tube. In this first portion of the tortuous carotid canal, the artery is accompanied with two or more branches of nerves from the superior cervical ganglion; these form a plexus around the posterior and external part of the ramus, more numerous than to any other part of the arterial system. The ramus at this point gives off a small ramification, which enters the anterior and inferior part of the tympanum, to be distributed on the mucous membrane covering the promontory, and anastomosing with a ramification of the middle meningeal ramusculus; also a small ramification passes to the vidian canal.

The ramus carotidis internus, at the upper part of its middle second portion, passes upwards and a little forwards to enter the cavernous sinus of the dura mater, along the anterior portion of the lower wall of which it runs, giving off two or more ramuli, termed the ramuli receptaculi. These form an interlacement with the nerves of the cavernous

ganglion; some ramusculi passing outward to the ganglion of the fifth pair, to anastomose with the middle meningeal ramusculus of the external carotid on the dura mater; also two or three ramifications to the dura mater, the pituitary body, the membrane of the sphenoidal sinuses, and the trunks of the neighbouring nerves.

The third portion of the internal carotid ramus commences at the side of the sella tursica, where it has perforated the dura mater; here it may properly be termed cerebral. After penetrating the dura mater, just externally and posterior to the optic nerve, the ramus ascends, and is inclined obliquely backwards and outwards, presenting a convexity towards the optic foramen, and being surrounded by a sheath of the arachnoid membrane. Opposite the internal extremity of the fissura Sylvii, this ramus terminates by dividing into its ophthalmic and cerebral ramuli.

(a.) The *ramulus ophthalmicus*—is given off from the convexity of the internal carotid ramus, where it faces the foramen opticum—through which it passes, being destined to supply the eye and its appendages. In traversing the optic foramen, with the optic nerve, it is first placed below and to the outer side of that nerve; it then crosses above it to gain the inner side of the orbit, and terminates at the inner canthus, by distributing ramusculi to the upper part of the face. While the ophthalmic artery is below and to the outer side of the optic nerve, it sends off the following ramusculi.

(α.) *Ramusculus lacrymalis*—which is the largest of its ramusculi, takes its course along the upper edge of the abductor oculi muscle, to gain the lachrymal gland, to which it is distributed. In passing from its origin to its termination, it sends out some ramifications externally through the malar bone, to anastomose with the deep temporal ramusculus of the internal maxillary. Within the orbit, also, it anastomoses with the middle meningeal ramusculus; and ultimately supplies the palbebra, anastomosing with the palpebral ramusculi.

(β.) *Ramusculus centralis retinæ*—also arises from the ophthalmic on the outer side of the ophthalmic nerve, which it soon penetrates, running along its axis to be distributed in minute branches upon the medullary expansion of the retina. Some of these small ramifications pass as far as the corpus ciliare; from which, in a very successfully injected eye, smaller ramifications may be traced to the crystalline lens. A very minute ramification may usually be seen running through the centre of the vitreous humour. The ophthalmic ramusculus having gained the superior surface of the optic nerve, sends off the (γ.) *ramusculus supra orbitalis*. This vessel passes upwards, above the levator palpebræ superioris, accompanied by the frontal nerve, and perforates the supra orbitar foramen to be distributed on the forehead. Within the orbit it sends off minute ramifications to the levator palpebræ, levator oculi muscles, and to the periosteum; when having issued from the superciliary foramen, it divides into internal and external ramifications. The internal anastomose with the nasal ramusculi of the facial, and with the corresponding ramifications of the opposite side; while the external pass outwards, to anastomose with the superficial temporal ramusculi. This ramusculus also supplies the upper eyelid, and the diploe of the frontal bone. The ophthalmic ramulus next gives off (δ.) *ramusculi ciliares* — which are very small, and are very frequently given off by other ramusculi of the ophthalmic ramulus. These ramusculi form three or more primary vessels, which surround the optic nerve, and then penetrate the sclerotic coat by twenty to thirty ramifications; most of these terminate in the choroid coat, and are named the short ciliary arteries: while on either side, parallel with the long axis of the eye, ramifications are seen passing between the sclerotic and choroid membranes, as far as the corpus ciliare, —these are termed the long ciliary arteries; which, passing under the ligamentum ciliare, subdivide, and forming frequent inosculations with each other, produce a circle of blood-vessels at the circumference of the iris. From the

whole of the inner side of the circumference of this circle, a great number of ramifications arise, which immediately bifurcate, and again anastomose so as to form a second vascular circle within the preceding: while again, from the inner circumference of this second circle, small vessels form radii towards the circumference of the pupil to form a third circle, by their anastomosing with each other. About two lines behind the transparent cornea, small ramifications enter the eye, which are given off from the muscular ramusculi, to be distributed to the anterior part of the choroid coat and iris. These have been termed the anterior ciliary arteries; they form numerous anastomoses with the long and short ciliary arteries, and together send ramifications both to the iris and ciliary processes.

(ε.) The *ramusculi musculares*—are irregular in their number and origin, coming off in one or two vessels from the ophthalmic, lachrymal, or supra orbital ramusculi. The superior ramusculus supplies the levator palpebræ superioris and levator oculi, and attollens oculum. The inferior ramusculus, more constant than the superior in its origin and larger in size, arises from the ophthalmic, between the ciliary or immediately after the lachrymal ramusculus. It descends on the inner side of the optic nerve, sending ramifications to supply the rectus externus, the rectus inferior, and the obliquus muscles; small ramifications to the adeps and periosteum, inferior eyelid and lachrymal sac; and others which anastomose with the infra-orbital ramusculus; and the ramifications, from four to five in number, which have already been described as anastomosing with the ciliary arteries. The ophthalmic ramulus having gained the inner side of the optic nerve, sends off the following ramusculi—

(ζ.) *ramusculus æthmoidalis posterior, et anterior.* These are frequently given off in a single vessel, which often divides into two branches to pass to the corresponding anterior and posterior orbitar foramina; at other times, they are distinct ramusculi. The *ramusculus æthmoidalis posterior*—passes forwards along the orbitar plate of the

æthmoid bone, to enter the posterior orbitar foramen; and
having gained the interior of the skull, it divides into rami-
fications to supply the ethmoid cells, and the anterior part
of the dura mater. The *ramusculus æthmoidalis anterior*—
continues still farther forwards along the inside of the orbit,
until it reaches the anterior orbitar foramen, through which
it passes, accompanied by the ethmoidal ramification of the
ophthalmic nerve; it is then distributed to the anterior
ethmoidal cells, sending some ramifications downward to
the nose, through apertures on the cribriform plate of the
ethmoid bone to be distributed to the pituitary membrane.

(*n.*) *Ramusculus palpebralis superior, et inferior*—arise
generally from the ophthalmic, near the inner canthus, and
a little beyond the cartilaginous pully of the obliquus oculi
superioris. The superior palpebral ramusculus supplies the
upper half of the orbicularis palpebrarum, and parts ad-
jacent. There is one small ramification running forwards
on the edge of the superior tarsal cartilage to the Meibomian
glands, finally anastomosing with the supra orbital ramus-
culus. The inferior ramusculus descends behind the tendon
of the orbicularis palpebrarum, furnishing ramifications to
that muscle, lachrymal sac and caruncula; then to the
inferior part of the orbicularis palpebrarum; while another
ramification, more outwards, is distributed to the tarsus,
Meibomian glands, and tunica conjunctiva. It anastomoses
with the angular, lachrymal, infra orbitar, and temporal
ramusculi. The ramusculi by which the ophthalmic ramulus
terminate, are—

(9.) *Ramusculus nasalis.*—This vessel is given off above
the tendon of the orbicularis palpebrarum, and below the
pully of the obliquus internus; it descends along the side
of the root of the nose, and distributes minute ramifications
to the lachrymal sac, neighbouring muscles, and anasto-
moses with the facial ramulus.

(*i.*) *Ramusculus frontalis*—the last vessel given off by
the ophthalmic, ascends from the upper and inner part of
the orbit, underneath the orbicularis palpebrarum; it divides

into several ramifications, which are distributed to the orbicularis palpebrarum, frontalis, and corrugator supercilii muscles; anastomosing with the superficial, temporal, supraorbital, and the opposite frontal ramusculi.

The internal carotid artery is but little diminished in size by the separation of the ophthalmic ramulus. Its remaining ramuli should be examined by removing the brain from the interior of the skull, with its arteries injected, in order to demonstrate them in their relative position. In the removal of the brain, the internal carotid will be necessarily divided, and should be separated immediately posteriorly to its ophthalmic ramulus. The next ramulus given off by the internal carotid, is the

(b.) *Ramulus communicans posterior.*—This directs itself backwards and slightly inwards, to anastomose with the posterior cerebral ramusculi of the ramulus basilaris; and thus forming a considerable portion of the circle of Willis. This communicating ramulus is placed between the pia mater and tunica arachnoidea, to the outer side of the infundibulum and mammillary processes, and to the inner side of the middle lobe of the brain. In its course it gives off small ramusculi to the thalamus nervi optici, and optic nerve of its own side; to the infundibulum, processus mammillaris, and peduncles of the brain. A ramification to the choroid plexus is sometimes given off from this communicating ramulus, at others from the internal carotid itself; in either case, entering the anterior extremity of the inferior cornu of the lateral ventricle.

(c.) *Ramulus cerebri anterior*—is the next branch given off by the internal carotid; it directs itself forwards and inwards, to reach the fissure between the two anterior lobes of the brain; and in passing forwards, converges towards its fellow on the opposite side, where they soon become connected through the intervention of the ramulus communicans anterior. After this junction, the anterior cerebral ramulus still continues forwards as far as the anterior extremity of the corpus callosum, around which they turn

upward, and reach the upper surface of that body, where they gain the name of (a.) *ramusculi corporis callosi*— and pass to terminate in ramifications, which are distributed to the inner surface of each hemisphere of the brain as far as the posterior lobes. Before the ramulus cerebri anterior passes around the corpus callosum, it distributes small ramusculi to the fornix, and the anterior commissure of the third ventricle.

(d.) *Ramulus cerebri medius*—is the terminating branch of the internal carotid, and is much larger than the preceding; it passes backwards and outwards to gain the fissura Sylvii, where it divides into two considerable ramusculi; the one passing to the anterior, the other to the middle lobe of the brain, to be distributed to the pia mater of both of these lobes, but principally on the latter. A ramification of this vessel enters the inferior cornu of the lateral ventricle to supply the plexus choroides, and sometimes constitutes the true choroid ramusculus; but which is as frequently sent off, either from the internal carotid, or ramulus communicans posterior.

### (5.) *Of the Subclavian Arteries.*

The arteriæ subclavii, similar to the carotids, do not arise alike on each side; the one on the right commencing from the arteria innominata, and that on the left from the arch of the aorta. The portion of the left subclavian, arising within the chest from the arch of the aorta, has been described *(Vide* p. 10); but should be again studied by the pupil, before he begins to examine the remaining portions of the subclavian arteries, which are so nearly similar on both sides, that the description of one will serve for both vessels.

They commence from the sterno clavicular articulations, and terminate at the anterior edge of the first rib. On examining the commencement of each artery from this spot, there is some difference to be observed between the right and left: the former, passing outwards in a gentle curve from the arteria innominata; while on the contrary, the left

takes a very sudden turn, forming a considerable angle with its thoracic portion, as it directs itself outwards towards the scalenus anticus muscle.

In this extent, from the sterno clavicular articulation, to the first rib, the subclavian arteries form a curve, the convexity of which is directed upwards, and the concavity downwards towards the apex of the lungs, which they in part enclose.

The subclavian arteries, in this course, may be divided into three parts: the first third, between the sterno clavicular articulation, and the inner, or tracheal edge of the scalenus anticus muscle; the middle third, while between the two scaleni; and the outer third, while between the acromial or outer edge of the scalenus, and the anterior edge of the first rib.

Each of these portions presents sufficient surgical and anatomical interest, to render their separate description adviseable.

The first or tracheal portion, extending from the sterno clavicular articulations to the scalenus muscle, is deeply seated, and covered by the following parts, besides the skin and platysma myoides:—The sternum and clavicle, sterno cleido mastoideus, sterno hyoideus, and sterno thyroideus muscles; the par vagum, the anterior filaments of the inferior cervical ganglion of the sympathetic nerve, and the jugular and vertebral veins: behind this portion of the artery are found, the posterior branches of the sympathetic, and on the right side the recurrent laryngeal nerve; which nerves pass between the artery, and the longus colli muscle. It is this portion of the subclavian artery which sends off all its branches, excepting one; and for this reason, as well as from its depth and contiguity to important parts, the possibility of its being made the subject of operation for aneurism is precluded.

The second, middle, or scalenar portion of the subclavian artery, is placed between the scalenus anticus, and scalenus medius muscles. In front of the scalenus anticus, the

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phrenic nerve passes downwards vertically into the chest; consequently at right angles with the artery, and separated from it by that muscle. The subclavian vein passes in front of both muscle and nerve, in its course to the vena innominata. This portion of the artery has its concavity resting on the pleura covering the apex of the lung, and gives off one branch to the deep region of the neck. Like the former, it is not made the subject of operation from its deep situation between the scaleni muscles.

The third, or acromial portion of the subclavian artery, extends downwards and outwards, accompanied by the brachial nerves, and omo hyoideus muscle, which are above and to its outer side. It is the most superficial part of the artery, being covered only by integuments, platysma myoides muscle, cervical fasciæ, and glands. It rests behind, upon the scalenus medius muscle, and first rib; and is bounded anteriorly and inferiorly, by the subclavian vein, and the termination of the external jugular.

It is this outer third of the subclavian artery, around which a ligature is placed to cut off the flow of blood to an aneurismal tumour in the axilla.

The branches which are sent off by the subclavian artery, are eight in number; seven of which arise from its tracheal third. The directions in which they are distributed, are three upward, three outward, and two downward. Those upward—first the

(A.) *Ramus vertebralis*—arises from the posterior and upper part of the subclavian artery, between the scaleni and longus colli muscle; and extends to the junction of the medulla oblongata with the pons varolii, where it terminates by uniting with the corresponding ramus of the opposite side, to form the basillary ramus; hence it is better to describe its cervical, and cerebral portions, separately.

In the neck, directly after the vertebral ramus is separated from the subclavian, it passes upwards in front of the transverse process of the seventh cervical vertebra, and behind the inferior thyroideal artery; and where generally, on

gaining the transverse process of the sixth cervical vertebra, it enters its foramen, although sometimes it will pass up as high as the fourth, and then ascends the canal produced by the foramina common to the transverse processes of all the cervical vertebræ. In this course it passes in front of the cervical nerves, as they emerge from the spinal marrow; as soon as it enters the transverse canal, it is concealed by it until it reaches the space between the second and first cervical vertebræ, where it may be seen by removing the trachelo mastoideus muscle; making a curve in a vertical direction, to gain the foramen in the transverse process of the atlas; and then traversing it, passes inwards and backwards, forming a second curve in a horizontal direction, between the atlas and occiput,—embracing the posterior circular ligament of the occipito atlantal articulation, which it perforates below the suboccipital nerve, to gain the foramen magnum,

The cervical portion of the vertebral artery, while traversing the transverse canal, sends off numerous muscular ramuli in every direction, to supply the posterior, lateral and anterior muscles of the spine; and some small ramusculi pass inward to the medulla spinalis, through the intervertebral foramina, and anastomose with those of the opposite side. While between the vertebra dentata and atlas, where it has been described to form its vertical curve, it supplies ramifications to the deep muscles of the back; and while between the atlas and occiput, it sends off considerable ramifications under the complexus muscle, anastomosing with the occipital ramusculi, and with the deep cervical of the subclavian, on the semi spinalis colli muscle,—supplying also the recti postici, and obliqui capitis muscles; its transverse curve being, in fact, situated in the triangular space formed by them.

The vertebral ramus, then passes from the atlas to the foramen magnum, penetrating the posterior circular ligament and dura mater, gains the side of the medulla oblongata; and converging as it passes upwards and forwards

towards the opposite side, it runs in a groove between the corpora pyramidalia and olivaria ; and at the junction of the medulla oblongata with the pons varolii, the two vertebral rami meet to form the basilar.

While passing through the dura mater the vertebral ramus sends off its (*a.*) *posterior or occipital meningeal ramulus*, which ramifies upon the dura mater. The next vessel usually sent off from the vertebral is (*b.*) *ramulus spinalis posterior*—which directs itself downwards and obliquely inwards, towards the ramulus of the opposite side, and gradually expends itself in the spinal marrow of the lumbar region. The vessel of either side is frequently anastomosing with the other by small transverse ramusculi.

(*c.*) *Ramulus spinalis anterior* — which is not unfrequently a ramusculus of the inferior ramulus of the cerebellum, descends in a tortuous course along the anterior surface of the medulla oblongata, converging towards the artery from the opposite side, so as to unite near the foramen magnum, —producing one branch, which continues along the whole length of the anterior part of the spinal marrow, as far as the junction of the sacrum with the os coccygis, where it terminates by anastomosing with the lateral sacral arteries. In this whole extent, it also frequently anastomoses with the posterior spinal arteries.

(*d.*) *Ramulus cerebelli inferior vel posterior*—is generally given off by the vertebrals before they form the basilar, but not unfrequently from that vessel. It directs itself outwards across the corpora pyramidalia, separating the filaments of the pneumo-gastric from those of the accessory nerve, at the same time distributing small ramifications to them. The ramulus continues backwards and downwards in a serpentine direction, to gain the inferior surface of the cerebellum, upon the pia mater of which it is distributed.

(*e.*) *Ramulus basilaris*—which has already been mentioned as being formed by the union of the two vertebrals, extends from the posterior, to the anterior part of the pons varolii, commencing at the junction of that body with the

medulla oblongata. In this course the ramulus lies in a groove of the pons varolii, posteriorly separating the sixth pair of nerves from each other, and giving small ramifications on either side to be distributed to the inferior surface of the pons varolii, the cerebellum, and the medulla oblongata. The basilary ramulus then terminates by dividing into two pair of ramusculi; the first to supply the cerebellum, the second the cerebrum.

(*a.*) *Ramusculus cerebelli anterior vel superior*—passes outwards to wind over the upper part of the tuber annulare, to ascend upon the upper surface of the cerebellum, immediately behind the tubercula guardrigemina, to which it sends ramifications, as well as to the pituitary gland, and the valve of Vieussens. Sometimes from this ramusculus, at others from the basilar itself, a ramification is sent to the ear, through the meatus auditorius internus, dividing the postio mollis from the postio dura. The superior arterial ramusculus of the cerebellum, terminates by distributing itself to the pia mater.

(*β.*) *Ramusculus cerebri posterior*—by which the basilar ramulus terminates, proceeds on either side forwards and outwards, at first parallel with the last described ramusculus, having the third pair of nerves between them. It still continues outwards, winding around the crus cerebri to gain the inferior surface of the posterior lobe of the cerebrum, to which it is finally distributed. Each of these ramuli receives the ramulus communicans from the internal carotid, which inosculates with them on the inner side of the third pair of nerves—thus completing the posterior portion of the arterial circle of Willis; the anterior part being formed by the anterior ramuli of the cerebrum, and their transverse communicating vessel.

Within the space surrounded by these ramuli, which is of a quadrangular figure, is placed the processus mammillares, the infundibulum, and the pons Tarini.

The ramus next given off by the subclavian, is a short vessel which divides into several ramuli; it is termed the

(B.) *Ramus axis thyroideus*—and is placed immediately on the tracheal, or inner edge of the scalenus anticus muscle. The ramuli usually given off by this trunk, are four in number; two of which are directed upward, and two outward. In this distribution, however, there occurs considerable variety; as occasionally one or two, or all of them, are given off from the subclavian artery separately.

(*a.*) *Ramulus thyroideus inferior, vel ascendens*—arises rather to the outer side of the vertebral ramus, and generally opposite to the origin of the internal mammary. It ascends along the inner edge of the scalenus anticus muscle, as high as the fifth cervical vertebra, where it is directed inwards to gain the thyroid gland, passing behind the carotid sheath and its contents, between it and the vertebral ramus,—which, however, is separated from it by its bony canal. In this course it sends off first numerous muscular ramusculi; and arriving at the side of the trachea, supplies it and the œsophagus; it then continues, but little diminished in size, to the posterior surface of the thyroid gland, to which it is distributed, — inosculating with branches of the superior thyroideal from the external carotid ramus.

(*b.*) *Ramulus cervicalis ascendens*—is a small branch either sent off from the last described artery, from the thyroid axis, or from the subclavian itself; it ascends along the inner edge of the scalenus anticus muscle, parallel with the phrenic nerve, first resting on the longus colli, then on the rectus capitis anticus major, reaching as high as the rectus capitalis lateralis,—in which course it supplies all these muscles; sending also small ramifications inward through the intervertebral foramina, along the roots of the cervical nerves, to anastomose with the spinal ramusculi of the vertebral ramus; with which latter it also anastomoses on the posterior part of the neck, upon the deep-seated muscles of that region.

(*c.*) *Ramulus transversalis, vel superficialis colli*—is most frequently given off from the thyroid axis on the inner side of the scalenus anticus muscle, which it crosses, as well as

the brachial plexus of nerves,—being covered by the trape-
zius muscle.   In this situation it sends off numerous small
ramusculi to the muscles and nerves in this region; it then
divides into the superficial cervical and posterior scapular
ramusculi.

   (*a*.) The *superficial cervical*—proceed in a tortuous direc-
tion upward, beneath the trapezius, to supply the superficial
muscles of the back,—anastomosing with the occipital ra-
mulus, and being lost in the integuments.   It also sends
some few descending ramifications along the posterior sur-
face of the trapezius to the spine of the scapula, where it
anastomoses with the supra scapular artery.

   (*ß.*) The *posterior scapular ramusculus*—which appears
to be a continuation of the ramulus, passes, deeply covered
by the rhomboidei and the levator scapulæ muscles, to gain
the posterior costa of the scapula—along which it descends
vertically, to terminate by anastomosing at the inferior angle
with the infra scapular of the axillary artery.   In this course
it sends off numerous muscular ramifications, anastomosing
with the deep cervical, and posterior ramifications of the
intercostal rami.

   (*d.*) *Ramulus supra scapularis*—is generally the last
vessel given off from the thyroid axis, and like the above de-
scribed ramulus it crosses the scalenus anticus in its course
outwards, running parallel to the subclavius muscle, with
which it is more or less connected by the fascia of the neck;
it is covered by the trapezius muscle, and on reaching the
superior costa, it passes over the posterior ligament of the
scapula, which separates it from the supra scapular nerve,
—both of them being placed between the origin of the omo
hyoideus muscle, and the root of the coracoid process.
While in its course to the posterior ligament of the scapula,
it sends off small muscular ramifications; and at the liga-
ment it sends off the superior acromial ramusculus, which
perforates the trapezius muscle; and on the upper surface
of the acromion supplies the deltoid,—anastomosing with
the humoral thoracic ramulus of the ramus axillaris.   A

small ramusculus to the supra spinatus muscle is next given off in the fossa supra spinata, running to the posterior costa of the bone, and anastomosing with the posterior scapular branch of the superficial cervical ramusculus. The supra scapular ramulus terminates by a descending ramusculus, which passes through the acromial notch to gain the fossa infra spinata,—there dividing into several ramifications supplying the infra spinatus, the long head of the triceps, and teretes muscles; and anastomosing, posteriorly, with the posterior scapular ramusculus of the superficial cervical ramulus; and anteriorly, with the subscapular ramus of the axillary artery.

(c.) *Ramus mammillaris internus.*—It descends into the chest, taking its course downwards and inwards along the posterior surface of the cartilages of the ribs and external intercostal muscles, between them and the triangularis sterni. As it descends it diminishes in size, converging towards the artery of the opposite side; it reaches as low as the ensiform cartilage of the sternum, where it divides into its two terminating abdominal ramuli. When this ramus first enters the chest, it is crossed by the phrenic nerve, which is anterior to it, above being to its outer, and below to its inner side. In this situation the internal mammary ramus gives off four or five (*a.*) *anterior intercostal ramuli.* These pass first between the pleuræ and internal intercostal muscle, and then between the internal and external intercostal muscles; and expend themselves by anastomosing with the posterior intercostal arteries of the aorta, and by distributing large branches to the mamma of the female, anastomosing with the thoracic branches of the axillary artery. Small ramusculi are distributed to the anterior mediastinum and its contents, and supply the remains of the thymus gland; and others pass to the pericardium, pleura, and diaphragm.

The next ramulus from the internal mammary is so regular in its course accompanying the phrenic nerve, that it has been named (*b.*) *ramulus, comes nervi phrenici—*

it supplies the diaphragm, upon which it is lost. In the interspace between the cartilages of the sixth and seventh ribs, the internal mammary divides into its phrenic and abdominal ramusculi.

(c.) *Ramulus diaphragmaticus vel phrenicus*—takes a course outwards, along the cartilages of the last rib, and distributes itself to the diaphragm, and to the transversalis abdominis muscle; anastomosing with the inferior intercostal, superior lumbar, and circumflex ilii vessels.

(d.) *Ramulus abdominalis*—on descending, passes behind the rectus muscle, and anastomoses with the ascending ramusculus of the epigastric.

(D.) *Ramus intercostalis superior*—is the last branch given off from the first third of the subclavian artery, from the posterior part of which it arises, close to the scalenus anticus muscle. It then takes its course downwards, along the posterior parietes of the chest, but anterior to the neck of the first rib, at the inferior edge of which it sometimes terminates, while at others it passes in a similar manner in front of the second, and even of the third rib. In the intercostal space or spaces, according to the length of this vessel, it divides into posterior and external ramuli.

(a.) *Ramulus posterior*—directs itself backwards, between the transverse processes of the dorsal vertebræ, dividing into muscular and internal ramusculi. The internal passing through the intervertebral foramina to supply the spinal marrow, the muscular are distributed to the deep-seated muscles of the back.

(b.) *Ramulus externus*—is distributed to the intercostal muscles, sending some few ramusculi forwards to the œsophagus and bronchi. In the second intervertebral space, the ramus intercostalis superior terminates by two ramuli, precisely similar to the preceding vessels, anastomosing with the upper intercostal arteries from the aorta.

(E.) *Ramus cervicalis profundus, vel posterior*—is usually given off from the middle third of the subclavian artery, while placed between the two scaleni muscles ; but is some-

times arising in common with the superior intercostal artery.
This ramus first passes upwards, outwards, and backwards,
gaining the interspace of the transverse processes of the
sixth and seventh cervical vertebræ—in this passage gene-
rally separating the axillary plexus of nerves. Having
gained the posterior region of the cervical vertebræ, it
ascends between the spinous and transverse processes of
those bones, and divides into numerous muscular ramuli—
supplying the deep layer of muscles of the cervical region.
One ramulus is particularly observable, which passes up-
wards between the semi-spinalis colli, and complexus mus-
cles, to inosculate with the occipital and vertebral ramifica-
tions—this vessel may be termed (*a.*) *ramulus anastomodicus.*

(5.) *Arteria axillaris.*—This vessel cannot be considered
as a ramus of the subclavian artery, being in fact, as well
as the brachial, the continuation of the main trunk of that
vessel ; and which anatomists have named arteria axillaris,
and arteria brachialis, to facilitate the description of its
course through the regions in which it is situated ; and I
may therefore, consistently with the plan which I have
adopted, still denominate these vessels as arteries.

The arteria axillaris extends from the anterior edge of the
first rib to the inferior edges of the latissimus dorsi, and
teres major muscles. In this course, when the arm is
hanging by the side, the artery forms a curve, the convexity
of which is directed upwards and outwards, and the con-
cavity downwards and inwards.

The axillary artery may be divided into three portions,
sufficiently marked by its relative position with the axillary
plexus of nerves. The upper third has the whole of the
axillary plexus above and to its outer side ; the middle third
is completely surrounded by this plexus ; while the inferior
third has the median nerve in front of it, the spiral and
circumflex nerves behind it, the external cutaneous nerve to
its outer, and the internal cutaneous and ulnar nerves to its
inner side.

The muscles which cover the axillary artery anteriorly,

are, the platysma myoides, pectoralis major, pectoralis minor, coraco brachialis, and biceps; its accompanying vein is also anterior to it. The artery rests upon the first intercostal muscle, in the upper digitation of the serratus magnus, from which muscle it then becomes separated by a considerable quantity of cellular membrane; and just before its termination, it lies upon the tendinous insertions of the latissimus dorsi and teres major.

The rami which are distributed from the axillary artery, although irregular in their number, pass inward to supply the exterior of the thorax, outward to supply the muscles of the shoulder, and backward to supply the glands and adeps within the axilla.

The internal rami, generally four in number, are termed—rami thoracici, and are distinguished by the following names.

(A.) *Ramus thoracicus acromialis*—is of considerable size, and is separated from the fore part of the axillary artery immediately above the upper edge of the pectoralis minor, where it is concealed by the pectoralis major. It then takes its course upwards, outwards, and forwards, to gain the anterior edge of the deltoid muscle; sending off ramuli to the subclavius, serratus magnus, and intercostal muscles, and then dividing in two terminating ramuli.

(*a.*) *Ramulus superior*—ascends between the deltoid and pectoralis major muscle, as high as the acromio clavicular articulation; when it divides into two ramusculi,—the inner to supply parts about the clavicle, the outer distributed to the capsular ligament of the shoulder-joint, and the under surface of the deltoid muscle; and terminating by anastomosing with the ramulus supra scapularis.

(*b.*) *Ramulus inferior*—takes its course downwards, between the pectoralis major and deltoid muscles, accompanying the vena cephalica; and terminates by small muscular ramusculi, some of which anastomose with the rami articulares.

(B.) *Ramus thoracicus supremus*—is not unfrequently arising in common with the last described ramus, but

generally immediately below it. It passes inwards along the superior edge of the pectoralis minor muscle, and distributes itself to both pectoral muscles—the larger of which must be removed in order to expose this ramus. It also supplies in part the parietes of the thorax, inosculating with the ramus mammillaris internus, and the rami intercostales.

(c.) *Ramus thoracicus longus*—arises from the axillary artery, below the last two rami, and just at the inferior edge of the pectoralis minor muscle, along which it takes its course forwards and downwards, between the pectoralis major and the serratus magnus muscles, to both of which it is distributed; and becoming subcutaneous, it divides into small ramifications, which supply the mammæ. It anastomoses with the intercostales internal mammary and superior thoracic rami.

(d.) *Ramus thoracicus alaris.*—This branch is very irregular as to its origin, frequently arising from some of the thoracic branches, and is sometimes entirely wanting. When arising from the axillary artery, it is given off about the middle of the axilla, and soon divides into numerous ramuli to supply the glands and cellular membrane in the cavity of the axilla—anastomosing with the intercostal arteries; and from them they sometimes arise.

(e.) *Ramus subscapularis*—is separated from the axillary artery at the lower edge of the subscapularis muscle, and behind the axillary plexus. This branch takes its course along the inferior edge of the subscapularis, for about an inch and a half, when it divides into an anterior and a posterior ramulus; previous to which, however, it gives off some minute ramuli, to supply the glands in the axilla, and the subscapularis muscle.

(a.) *Ramulus anterior*—appears as if a continuation of the ramus subscapularis, taking its course along the lower edge of the subscapularis muscle, to the inner side of the serratus magnus and latissimus dorsi,—to both of which muscles it sends ramusculi. Close to the inferior angle of the scapula it subdivides into numerous ramusculi, which are

distributed to the teretes muscles, and anastomose freely
with the ramusculus scapularis posterior, of the ramulus
transversalis colli, from the thyroid axis.

(b.) *Ramulus posterior*—winds around the anterior costa
of the scapula, to gain the dorsum of that bone, passing in
a space which is bounded in front by the long head of the
triceps, below by the teretes, and above by the glenoid
cavity.   In this situation it sends off ramusculi to each of the
above-named muscles; from hence it passes to the fossa
infra spinata, dividing into two principal sets of ramusculi
—one superficial and the other deep.  The superficial set
supplies the integuments upon the dorsum of the scapula;
while the deep set passes between the bone, the infra spi-
natus, and teres minor muscles; while one principal ramifi-
cation continues under the acromial notch to gain the fossa
supra spinata, where it anastomoses with the ramulus supra
scapularis; and posteriorly with the posterior scapular
ramulus; and at the inferior angle of the scapula with the
ramulus anterior.

(F.) *Ramus articularis, vel circumflexus posterior*—is
the next branch given off from the axillary artery, arising
from its posterior part, and sometimes in common with the
last-described ramus.   It takes its course backwards, be-
tween the neck of the humerus and the long head of the
triceps muscle; below the capsular ligament of the shoulder-
joint, and above the tendon of the latissimus dorsi; from
whence it continues around the bone, encircling its neck—
being here covered by the deltoid muscle.  In this situation
it sends off ascending, and descending ramuli.  The superior
supply the deltoid muscle, and ascend as high as the
acromion process and shoulder-joint—anastomosing with the
ramus thoracicus acromialis.  The inferior ramuli pass down-
ward, along the tendon of the deltoid muscle, to anastomose
with the ramus profundus superior of the brachial artery,
and with the ramus circumflexus anterior.  This ramus has
an accompanying nerve, arising from the axillary plexus.

(G.) *Ramus articularis, vel circumflexus anterior*—is a

smaller vessel than the preceding ramus, and is usually sent off from the axillary artery immediately below it. They however sometimes arise by a common ramus; at others it arises from the ramus subscapularis, or from the ramus profundus superior of the brachial artery. It directs itself under the coraco brachialis muscle, and the short head of the biceps; and thus passing behind the deltoid muscle, anastomoses with the posterior ramus. In this course it gives off ascending and descending ramuli;—the former to supply the capsular ligament, and the synovial membrane of the shoulder-joint; the latter are distributed to the muscles of the arm, and anastomose with the ramifications of the brachial artery. Such are the rami usually distributed from the axillary artery; but it not very unfrequently occurs, that this vessel divides high in the axilla into two equally-sized branches, producing great variety in its distributions. And this is a circumstance also attended with important pathological considerations, which will hereafter be alluded to.

(5.) *Arteria brachialis*—still a continuation of the subclavian, proceeds from the lower edge of the tendon of the teres major muscle, to the bend of the elbow; where usually opposite to the coronoid process of the ulna, it divides into its terminating rami. In this course it does not pass directly vertically, but obliquely from above to below, and from behind to before. It is covered, first, by the coraco brachialis muscle, by the inner edge of the biceps, and by the fascia of the arm; but at the bend of the elbow it sinks deeper, and is covered by the aponeurosis of the biceps muscle, and the pronator radii teres. Posteriorly, it rests upon the triceps, the tendinous insertion of the coraco brachialis, and the brachialis internus muscle. The superficial veins are separated from the artery by the fascia of the arm, but the artery has its venæ comites accompanying it. The brachial artery sends off numerous branches to supply the muscles of the arm, and may be described as anterior, posterior, external, and internal branches. The three first sets supply the muscles in their corresponding situations,

and have no distinct names; but the internal rami form most essential anastomoses, and are therefore denominated accordingly.

(A.) *Ramus profundus superior.*—This branch is sometimes given off by the subscapularis, or posterior circumflex ramus; but when from the brachial artery, it is separated from it about an inch below the tendinous insertion of the teres major; it then takes its course backwards and outwards, between the triceps and the humerus, continues around to the back part of the humerus, penetrates the second portion of the triceps muscle, and then becomes anterior to the bone, and is placed between the triceps and brachialis internus muscles—losing itself in numerous muscular and anastomosing ramifications, upon the outer side of the elbow-joint. In this course it sends off several ramuli; first to the triceps, immediately after its separation from the brachial artery; while between the triceps and the middle of the back part of the humerus, it sends a ramulus along the bone as far as the olecranon of the ulna, to supply the elbow-joint, and anastomose with the recurrent ulnar and recurrent interosseal ramuli: near the elbow, just above the external condyle of the humerus, the ramus profundus terminates by dividing into anterior and posterior ramuli. The anterior descend between the supinator radii longus and brachialis internus muscles, deeply seated, and having the spiral and external cutaneous nerves, and cephalic veins anterior to them. These anastomose with the recurrent radial ramuli. The posterior ramuli pass behind the ridge of the external condyle, and anastomose with the recurrent interosseous ramusculi.

It is the ramus profundus superior which, proceeding from the inner to the outer side of the arm, anastomoses with the recurrent radial, and is the principal means of carrying on the circulation in obliteration of the brachial artery.

(B.) *Ramus profundus inferior*—is given off from the inner side of the brachial artery, just at the insertion of the coraco brachialis muscle; directly after its origin, it pene-

trates the intermuscular ligament, which proceeds from the insertion of the coraco brachialis to the internal condyle ; it descends to the fossa between the internal condyle and processus olecranon of the ulna; here being accompanied by the ulnar nerve, it terminates in numerous ramuli, which freely anastomose with the ramus anastomoticus magnus, and ramuli recurrentes ulnaris. In this course it sends off nothing but small distributions to the muscles; lying at first upon the tendon of the coraco brachialis, and in the rest of its extent upon the third head of the triceps muscle.

(c.) *Ramus anastomoticus magnus*—is given off from the brachial artery, in the inferior third of the arm, and close to the internal condyle; it immediately directs itself transversely inwards, crossing the brachialis internus muscle behind the median nerve ; it then perforates the intermuscular tendon between the brachialis internus and triceps, and divides into two ramuli: the anterior sends up superior ramusculi to anastomose with the ramus profundus inferior; and inferior ramusculi descend in front of the internal condyle, to anastomose with the anterior recurrent ulnar ramusculi. The posterior ramuli take their course downward, between the olecranon and internal condyle, giving ramusculi also to anastomose with the ramus profundus inferior, and with the posterior recurrent ulnar ramusculi.

(d.) *Ramus nutritius humeri*—is a small branch given off from the brachial, generally at the insertion of the coraco brachialis muscle, the tendon of which it perforates, and immediately enters the nutritious foramen of the os humeri, which is directed from above downwards.

The brachial artery terminates at the bend of the elbow, opposite the coronoid process of the ulna, in the ramus radialis and ramus ulnaris. The division of the brachial artery into these rami, is not always situated at this point, but occasionally occurs at various distances above it, and, sometimes as high as the axilla.

(e.) *Ramus radialis*—is smaller, and more superficial than the ramus ulnaris ; but appears, from its direction, more,

like a continuation of the brachial artery. It extends from its division from the brachial to the palm of the hand, where it terminates by forming the deep palmar arch. In this course, it may first be described in front of the radius, next behind the carpus, and lastly in the palm of the hand.

In front of the radius, it first lies upon the supinator radii brevis, separated from it by a small quantity of adeps, and cellular membrane; it then crosses the insertion of the pronator radii teres ; next it runs along the flexor tertii internodii pollicis, reaches the pronator quadratus, upon which it passes; and lastly, gains the radius, running around to the posterior part of the wrist-joint. It is covered anteriorly, in the superior third, by the supinator radii longus, and pronator radii teres ; below, it is superficial, and its pulsation may readily be felt, being only covered by the integuments and aponeurosis of the fore arm. On its radial, or outer side, it is bounded by the supinator radii longus, and its accompanying nerve; on its inner, or ulnar side, it has above, the pronator radii teres, and below, the flexor carpi ulnaris.

The ramus radialis is usually accompanied by two venæ comites; and in front, although separated from it by the fascia of the fore arm, is placed the superficial radial vein. In this first part of the ramus radialis, numerous ramuli are sent off to supply the muscles :—anteriorly, to the pronator radii teres, aponeurosis, and integument of the fore arm ; posteriorly, to the muscles already named, upon which it rests in its course ; externally, to the supinator radii longus, and extensores carpi radiales; and internally, to the common flexors of the fingers, and wrist-joint. Besides these muscular ramuli, others are given off which are to be more particularly noticed.

(a.) *Ramulus recurrens radialis.*—This vessel is placed between the supinator radii longus, which covers it, and the supinator radii brevis, upon which it rests ; and to both of which it sends ramusculi: it then directs itself upwards, in front of the external condyle of the humerus, between

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the supinator radii longus, and brachialis anticus muscles; where it divides into internal and external ramusculi:—the external anastomose with the ramus profundus superior; and the internal, in front of the elbow-joint, with the ramus anastomoticus magnus, the anterior recurrent ulnar, and interosseal ramuli.

(b.) *Ramulus superficialis volæ*—is given off usually about an inch above the carpus; it is very variable in its size, and passes superficially downwards, crossing the annular ligament, and origin of the muscles of the thumb—to both of which, as well as to the integuments of the palm of the hand, it distributes small ramusculi. It terminates with the extremity of the superficial palmar arch, which it may be said to complete.

This vessel is, however, so variable in its size, as sometimes scarcely to be distinguished; while at others, it is so large, as to appear like a continuation of the ramus radialis: under such circumstances, it not only forms an important part of the superficial palmar arch, but also distributes digital ramusculi to the thumb and fore finger.

While the ramus radialis lies upon the bone below the pronator quadratus muscle, it sends off—

(c.) *Ramulus radialis carpi anterior.*—This small vessel takes its course inwards, underneath all the flexor tendons of the fingers, and supplies the ligaments of the wrist-joint; anastomosing, above, with the ramulus interosseus, and internally, with its corresponding ramulus from the ulnar artery.

In the second part of the course of the ramus radialis, as it passes around the outer side of the carpus, it lies upon the ligaments of the wrist-joint, and upon the head of the first phalanx of the thumb—being covered by its three extensor tendons, and by the fascia and skin. In this situation, it gives off—

(d.) *Ramulus dorsalis carpi radialis*—which takes its course inwards, underneath the tendons of the extensors to the wrist and fingers—there supplying the ligaments of the

joint; and terminates by anastomosing with a similar ra-
mulus of the ulnar ramus. It distributes superior ramus-
culi to anastomose with the posterior interosseal ramulus,
and inferior ramusculi which supply the interosseii muscles,
and anastomose with the deep palmar arch.

(e.) *Ramuli dorsales pollicis*—generally arise by two
ramuli, which proceed along the dorsum of the thumb to
supply both its radial and ulnar sides; that on the ulnar side,
sends a ramusculus to the radial side of the index finger,
which has been named the (α.) *ramusculus dorsalis indicis*.

The ramus radialis, in its passage to the palm of the hand,
passes between the abductor indicis and adductor pollicis
muscles: in this situation, it divides into its three termi-
nating ramuli.

(f.) *Ramulus magnus vel princeps pollicis*—passes for-
wards to the anterior edge of the adductor pollicis, and at
the lower extremity of the first phalanx of the thumb; it
divides into two digital ramusculi, which supply both radial
and ulnar sides of the palmar surface of the thumb.

(g.) *Ramulus radialis indicis*—takes its course along
the radial side of the fore finger, the palmar surface of which
it supplies—anastomosing on the anterior phalanx with the
ramulus ulnaris indicis of the superficial palmar arch. This
ramulus, while in the palm, generally anastomoses also with
the outer extremity of the superficial palmar arch.

(h.) *Ramulus palmaris profundus*—passes transversely
from between the abductor indicis and adductor pollicis,
sinking deeply into the palm of the hand; and resting upon
the metacarpal bones and interosseii muscles, reaches the
metacarpal bone supporting the little finger, where it ter-
minates by anastomosing with the deep ramulus of the
ramus ulnaris—thus forming the deep palmar arch. The
convexity of this arch is directed downwards, and is placed
in a space midway between the superficial palmar arch and
the carpus, being covered by the flexor tendons of the
fingers, and the lumbricales muscles. From the convexity of
the arch are sent off ramusculi, to supply the interossei

muscles, and these proceed forward to the anterior extremities of. the metacarpal bones, to anastomose with the digital ramusculi of the superficial palmar arch : from the concavity of the deep palmar arch, small ramusculi are directed upward, to anastomose with the ramuli arteriores carpi.

: (F.). *Ramus ulnaris*—extends from opposite the coronoid process of the ulna to the palm of the hand, where it terminates by forming the superficial palmar arch. It is larger than the radial ramus, and passes more obliquely downwards, being first situated between the superficial and deep layer of muscles ; but about the middle of the fore arm it emerges from between them, becomes superficial, and passes vertically downwards to the ligamentum carpi annulare, where it is directed slightly. outwards, passing anteriorly to the ligament on the radial side of the pisiform bone.; and having gained the palm of the hand, it forms the superficial arch. In this course the ramus ulnaris is covered by the pronator radii teres, flexor carpi radialis, flexor sublimis digitorum, flexor carpi ulnaris muscles, and by the median nerve ; below the middle of the arm, it is covered by the skin, and aponeurosis of the fore arm ; in the hand, it lies beneath the palmaris brevis muscle, and palmar aponeurosis. It successively lies upon the brachialis internus, flexor digitorum profundus, ligamentum carpi annulare, and in the palm of the hand on the common flexor tendons of the fingers. On its ulnar side it is bounded by the ulnar nerve, and the flexor carpi ulnaris muscle; and while passing over the ligamentum carpi annulare, by the pisiform bone: on its radial side, it is bounded by the flexor digitorum sublimis.

The muscular ramuli which are given off from this branch, are as numerous as from the radial, and like them have no specific names. The following, however, require a more particular notice.

(a.) *Ramuli recurrentes anteriores*—generally arise by one common vessel, and soon divide into an anterior and posterior ramulus. The anterior takes its course outwards,

between the pronator radii teres and brachialis internus muscles, and ascends in front of the internal condyle, inosculating with the ramus anastomoticus magnus, and the ramus profundus inferior.

The posterior recurrent ramulus is directed inwards behind the pronator radii teres, flexor carpi radialis, and flexor digitorum sublimis, between it and the flexor profundus; in this situation, taking the course of the tendinous origin of the flexor longus pollicis : it then ascends behind the internal condyle, between the two origins of the flexor carpi ulnaris, being placed between the olecranon and internal condyle, where it is accompanied by the ulnar nerve : it terminates by anastomosing with the deep, and anastomotic branches of the brachial artery. Both of these recurrent ramuli supply the muscles upon which they rest.

(b.) *Ramulus interosseus*—is sent off from the ramus ulnaris, underneath the flexor sublimis digitorum, taking a course outwards and backwards to gain the upper interosseous space, opposite to the tubercle of the radius, where it divides into an anterior and posterior ramusculus. Before this division, however, it sends off—

(a.) *Ramusculi recurrentes interossei anteriores.*—These are very small vessels, but they surround the coronoid process of the ulna, and anastomose with the recurrent ramuli of the radial and ulnar rami.

(β.) *Ramusculus interosseus anterior*—takes its course downwards from the tubercle of the radius, accompanied by a branch of the median nerve, being covered by the flexor longus pollicis and flexor profundus muscles, to the superior edge of the pronator quadratus muscle, where it divides into two ramifications. The anterior of these supplies the pronator quadratus, continues downwards to the front part of the wrist-joint, and anastomoses with both the radial and ulnar anterior carpal ramuli. The posterior ramification pierces the interosseous ligament, immediately above the pronator quadratus muscle ; and descending along the back part of the radius, gains the posterior surface of the carpus,

to inosculate with the posterior carpal ramuli of the radial and ulnar rami.

(γ.) *Ramusculus interosseus posterior*—takes its course backwards, from opposite the tubercle of the radius, through the interosseous hiatus, between the upper edge of the interosseous ligament, and the oblique ligament of the middle radio-ulnar articulation, where it is covered by the extensor longus digitorum communis, and anconeus muscles, both of which it supplies. It then divides into two ramifications, the superior of which takes its course upwards, between the anconeus and supinator brevis muscles, passing around the external condyle between it and the olecranon; it anastomoses freely with the superior profunda, recurrent radial, and recurrent ulnar ramuli. The descending ramification of the ramusculus interosseus posterior, does not run downwards on the interosseous ligament, but is situated between the extensor common to the fingers, and the proper extensors of the thumb. When it reaches the upper part of the dorsal surface of the carpus, it distributes itself by anastomosing with the posterior carpal ramuli of the radial and ulnar rami, and with the posterior ramification of the anterior interosseal ramusculus.

(c.) *Ramuli carpi ulnares anteriores et posteriores*—are given off from the ramus ulnaris, just above the styloid process of the ulna; and taking their course, as implied by their name, upon the anterior and posterior surfaces of the carpus, they freely anastomose with the corresponding ramuli of the radial ramus, and the ramifications of the interosseal ramusculus.

The ramus ulnaris, while passing over the anterior surface of the ligamentum carpi ulnare to the radial side of the pisiform bone, distributes small ramifications to the neighbouring ligaments, cellular membrane, and integuments, and then divides into its two terminating ramuli.

(d.) *Ramulus communicans, vel profundus*—takes a deep course, accompanied by a branch of the ulnar nerve, between the flexor brevis and abductor minimi digiti muscles,

to inosculate with the deep palmar arch of the ramus radialis.

(e.) *Ramulus palmaris superficialis*—takes its course outwards, across the palm of the hand, to gain the centre of the metacarpal bone of the fore finger, where it anastomoses with the ramulus superficialis volæ, and the ramulus radialis indicis, thus completing the superficial palmar arch; the convexity of which is directed towards the little and index finger, and the concavity towards the ball of the thumb. A branch of the median nerve accompanies this arterial arch.

There are several ramusculi given off both from the convexity and the concavity of the superficial palmar arch. Those from the concavity, pass upward toward the carpus, to supply the lumbricales muscles, and anastomose with the anterior carpal vessels; those from the convexity, are generally four in number.

(a.) *Ramusculi digitales.*—The first or internal takes a course along the metacarpal bone of the little finger; it supplies the muscles proper to it, and terminates by being distributed to the ulnar side of the little finger. The second ramusculus runs in the interspace between the little and ring finger, and opposite the heads of the metacarpal bones; it divides into two ramifications, to supply the radial side of the little finger, and the ulnar side of the ring finger. The third ramusculus passes between the metacarpal bone of the ring and middle finger; and in like manner is divided, and supplies the radial side of the ring, and ulnar side of the middle finger. The fourth ramusculus is placed between the metacarpal bones of the middle and index fingers, and distributes itself to the radial side of the middle, and ulnar side of the index finger. The rest of the index finger, and the thumb, are supplied by similar distributions from the radial ramus. Each digital ramusculus has an accompanying branch, supplied from the median and ulnar nerves; and as they descend toward the extreme phalanx, they converge; and about the centre of the extreme phalanx,

they unite so as to form arches, from the convexity of
which numerous distributions are given off, supplying the
cutaneous papillæ, accompanied by numerous filaments of
nerves.

The THORACIC PORTION OF THE AORTA.—The name given
to this portion of the aorta, it is to be remembered, does not
apply to the whole of the vessel contained within the thorax ;
as in this sense, the arch of the aorta would also be implied
by the term. The thoracic portion of aorta commences
from the fourth dorsal vertebra, and extends to the twelfth,
where it passes between the crura of the diaphragm, and
becomes the abdominal aorta. In this course the aorta
is not completely vertical, but passes obliquely from above
to below, and from left to right, being first placed to the left
of the bodies of the dorsal vertebræ : while on the twelfth
dorsal vertebra, it is placed precisely in the mesian line. It
also forms a slight curve, the convexity of which is directed
to the right, and the concavity to the left—at the same time
conforming to the bend of the column of the dorsal vertebræ,
and consequently, being concave anteriorly, In this extent
it is placed in the posterior mediastinum (for an account of
which, vide page 185, Vol. III.), accompanied by the tho-
racic duct, vena azygos, œsophagus, and par vagum nerves.
It lies close to the vertebral column,—separated, however,
from it by the left intercostal veins, as they are seen passing
to the vena azygos. After having observed the relative
position of the thoracic aorta, the student should proceed to
the enumeration of the arteries given off from it. These are
described as anterior and lateral branches.

(6.) *Arteriæ bronchiales*—are the arteries given off from
the fore part of the thoracic aorta ; they are very variable in
their origin, commonly however arising by two distinct arte-
ries, one on either side ; at others, by four separate vessels ;
and sometimes by a single vessel, which afterwards divides
into four branches. They are given off from the aorta, whether
in common or separately, opposite the fifth dorsal vertebra.
The right bronchial artery, which not unfrequently arises

from the superior intercostal, takes its course backwards,
and to the right; immediately sending some small rami to
the œsophagus; it then continues its course along the
posterior surface of the right bronchus, upon which it
divides into numerous minute rami—supplying the pleura,
pericardium, and bronchial glands, and are finally distri-
buted upon the ultimate divisions of the bronchi within the
lungs.

The left bronchial artery, is separated from the aorta upon
a level with the right, and is distributed in a similar manner
upon its corresponding side.

(7.) *Arteriæ œsophageæ*—vary both in their number and
their size; frequently being six or seven, and small; at others,
only one, and proportionably large. They arise from the
front part of the aorta, immediately below the bronchials,
from which some of them are not unfrequently given off.
They divide themselves into ascending and descending
branches, which are distributed with the œsophageal plexus
of nerves, to the coats of the œsophagus.

The superior rami anastomose with the œsophageal ra-
mifications of the inferior thyroid ramulus of the subclavian
artery; and the inferior, with the œsophageal ramuli of the
cœliac axis.

(8.) *Arteriæ intercostales*—are separated from the sides
of the aorta, and are commonly nine in number on each
side; but they may be more or less, depending upon the
number of intercostal spaces, supplied by the superior inter-
costal ramus of the subclavian artery. The intercostal
arteries of the right side are longer than those on the left,
and cross the bodies of the dorsal vertebræ behind the
œsophagus, to gain their destination. They are not all
separated from the aorta at the same angle—the superior
forming an acute, while the inferior form an obtuse angle,
with the aorta: the former to retard, the latter to facilitate
the current of the blood. Their course and distribution are so
similar, that a description of one of these vessels, will serve
for the whole of them. They all pass behind the sympa-

thetic nerves, and their ganglia; and on entering the space
between the ribs and vertebræ, to which they belong, divide
into two rami.

(A.) *Ramus dorsalis*—which directs itself backwards be-
tween the corresponding transverse processes of the ver-
tebræ, is divided into superior, inferior, internal, and posterior
ramuli.

The superior and inferior, to anastomose with the inter-
costal arteries above and below it; the internal, to pass
through the intervertebral foramina, to supply the spinal
marrow and its sheath; and the posterior, to expend them-
selves upon the muscles of the back.

(B.) *Ramus anterior, vel intercostalis proprius*—is much
larger than the posterior ramus, and appears as a continu-
ation of the main artery. It winds outwards and slightly
downwards to gain the middle of the intercostal space, to
be placed between the pleura and external intercostal mus-
cles, where it soon divides into two small ramuli.

(a.) *Ramulus superior*—is the larger of the two, and
runs along the acute edge of the rib above it, accompanied
by a corresponding nerve and vein—the vein lies supe-
rior, while the nerve is inferior to it. At the anterior third,
the inferior ramulus leaves the rib (hence no groove at this
part of the bone), and is directed towards the middle of the
intercostal space—supplying the intercostal muscles, pleura,
and periosteum of the ribs. They terminate, those within
the intercostal spaces of the ribs, by anastomosing with
the ramuli intercostales of the internal mammary branch
of the subclavian artery; and those of the false ribs,
with the epigastric and circumflex iliac ramuli of the external
iliac.

(b.) *Ramulus inferior*—is much smaller than the preced-
ing, runs along the obtuse edge of the rib below it; and
terminates, by supplying the outer surface of the ribs, and
the muscles which cover them.

The superior aortic intercostal artery, anastomoses with
the inferior subclavian intercostal ramus; and the inferior

aortic intercostal artery, which is concealed by the pillars of the diaphragm, anastomoses with the first lumbar.

The posterior part of the thoracic aorta, sends off some small unimportant arteries to the cellular membrane within the posterior mediastinum.

The ABDOMINAL PORTION OF THE AORTA—extends from between the crura of the diaphragm to the junction of the fourth and fifth lumbar vertebræ, where it divides into the right and left common iliac artery. In this course it does not pass vertically, but with a degree of obliquity; being in the mesian line opposite the twelfth dorsal vertebra, and opposite the fourth lumbar; but between these points it inclines to the left of the bodies of the vertebræ, so as to present a concavity, facing to the right side. Again, its course is not vertical, owing to the form of the lumbar portion of the vertebral column; according with which, it is curved forwards, presenting its most anterior point on the third lumbar vertebra, a little above and to the left of the umbilicus.

The aorta, on leaving the thorax, does not immediately pass into the cavity of the abdomen, but is enclosed in a tendinous sheath, produced by the connecting fibres of the two cruræ of the diaphragm, and bounded behind by the last dorsal, and upper part of the first lumbar vertebra; so that, strictly speaking, this portion of the vessel is neither abdominal nor thoracic. The thoracic duct and vena azygos, pass through this opening, with the aorta between it and the right crus of the diaphragm. Directly the aorta has entered the abdomen, and is resting upon the first lumbar vertebra, it is covered by the lesser omentum, stomach, and solar plexus of nerves; and here gives off the diaphragmatic arteries, and the cœliac axis. Upon the second lumbar vertebra it is crossed by the vena portæ and pancreas; and immediately below the pancreas, by the duodenum; between which and the artery, the left emulgent vein is placed. In this extent the aorta next gives off the superior mesenteric, and the two emulgent arteries. Inferior to the

junction of the second and third lumbar vertebræ, and below where the duodenum crosses the aorta to its termination, it is covered by the transverse mesocolon, and root of the mesentery—having the vena cava to its right side, with the continuation of the sympathetic nerve ; while on the left side, it is also bounded by the sympathetic nerve, which is nearer to it in this situation.

The arteries that are given off from the aorta, within the abdomen, are destined to supply the viscera and parietes of that cavity; and are separated, some in pairs and some in single branches, in the following order:—(9.) Arteria phrenica dexter ; (10.) arteria phrenica sinistra ; (11.) arteria vel axis cœliaca ; (12.) arteria mesenterica superior; in the epigastric region. (13.) Arteriæ capsulares ; (14.) arteriæ renales ; (15.) arteriæ spermaticæ ; (16.) arteria mesenterica inferior ; in the lumbar region. (17.) Arteriæ lumbales ; (18.) arteria sacra media ; in the hypogastric region. The student cannot, however, dissect these vessels well in the above order of succession ; but it is better first to examine the three azygos arteries, which supply the organs of digestion, and their assistants, the chylopoetic viscera : after which these organs being removed from the abdomen, the remaining vessels may be conveniently traced.

(11.) *Arteria vel axis cœliaca*—is a short vessel given off from the aorta between the crura of the diaphragm, upon the last dorsal vertebra. It is bounded above by the lobulus spigelii, and below by the pancreas ; it directs itself forwards, and slightly to the right, for nearly an inch in extent, when it divides into three rami: ramus gastricus, vel coronarius ventriculi, ramus hepaticus, and ramus splenicus; but sometimes it gives off one or both of the phrenic arteries.

(A.) *Ramus gastricus, vel coronarius ventriculi*—is the smallest of the three branches given off from the cœliac artery. It takes its course upwards, forwards, and to the left; and having reached the lesser curvature of the stomach, it enters the space between the two layers of the

lesser omentum; and arriving at the junction of the œso-
phagus with the stomach, it divides into two ramuli.

(a.) *Ramulus superior*—takes its course upwards upon
the posterior surface of the œsophagus, which it supplies,
anastomosing with the œsophageal arteries of the thoracic
aorta: some ramusculi also pass downwards upon the great
*cul de sac* of the stomach, supplying its coats, and anasto-
mosing with ramuli of the splenic ramus.

(b.) *Ramulus inferior*—is the larger of the two, and
takes its course along the lesser curvature of the stomach,
from left to right, towards the pylorus, where it terminates
by anastomosing with the ramulus pyloricus of the ramus
hepaticus. In this course it sends off numerous ramusculi
upon the anterior and posterior surface of the stomach, sup-
plying that organ, and anastomosing with the left inferior
gastric ramulus of the splenic ramus.

(B.) *Ramus hepaticus.*—To expose this vessel the liver
must be raised, the anterior layer of the lesser omentum torn
through, and the pyloric extremity of the stomach drawn
downwards: it will then be seen to be a larger vessel than
the preceding: directing itself forwards, upwards and to the
right, towards the neck of the gall-bladder, and the trans-
verse fissure of the liver;—upon entering which, and being
placed before the vena portæ and behind the hepatic duct, it
divides into two terminating ramuli; but previous to this
division, it also sends off the following ramuli.

(a.) *Ramulus pyloricus*—is separated from the ramus
hepaticus, rather above the pyloric extremity of the stomach,
along which it runs, distributing ramusculi to it, and to the
pancreas; it then terminates in a ramusculus which is di-
rected along the lesser curvature of the stomach from right
to left, and anastomoses with the ramulus inferior of the
ramus coronarius.

(b.) *Ramulus gastricus inferior dexter*—arises behind the
pylorus, from the under part of the ramus hepaticus, takes
its course downwards, behind the pyloric extremity of the
stomach and pancreas, and then proceeds from right to left

along the greater curvature of the stomach, and terminates
by anastomosing· with the left inferior gastric ramulus.  In
this course it sends off, while in a vertical position behind
the pyloric extremity of the stomach, ramusculi which are
directed to the right, to supply the duodenum and posterior
surface of the pancreas; and to the left, to the inferior and
posterior surface of the pylorus.  While it is passing along
the greater curvature of the stomach, it sends ramusculi
superiorly· upon the anterior and posterior surface of that
organ, and which anastomose with the ramulus pyloricus of
the hepatic ramus; also descending branches to supply the
two laminæ of the great omentum upon which they pass,
and the transverse arch of the colon.  The ramus hepaticus
also sometimes before it divides, sends ramuli separately to
the pancreas, duodenum, and stomach; but which are most
frequently supplied as above described.

(c.) *Ramulus hepaticus dexter*—continues its course from
between the vena portæ and hepatic ducts, along the trans-
verse fissure of the liver; at the right extremity of which it
enters into the substance of the right lobe, to be ultimately
distributed in that organ.  Before it is thus divided, however,
it sends off—

(α.) *Ramusculus cysticus.*—This small vessel runs along
the duct of the gall-bladder to the neck, and from thence
distributes itself to the coats of that organ.

(d.) *Ramulus hepaticus sinister* — is smaller. than the
right hepatic ramulus: it proceeds obliquely ·upwards, to
enter the transverse fissure of the liver; and taking its
course to the left extremity of that fissure, it enters·the left
lobe, in which it is distributed, accompanying the ramifica-
tions of the vena portæ.

(c.) *Ramus splenicus.* — In the adult this is a larger
ramus than the hepatic, but the reverse occurs in the foetus.
To gain a proper view, of this branch, the stomach should be
separated from the œsophagus and turned down, when its
whole extent may be seen reaching from the cœliac axis to
the spleen, in which it is distributed.  It passes from right to

left, forming numerous tortuosities, being lodged in a groove in the upper edge of the pancreas, accompanied by its corresponding vein, which is inferior to it. In this course it first sends off—

(a.) *Ramuli pancreatici*—the number of which is irregular. They pass from the lower part of the ramus to supply the parenchyma of the pancreas, in the substance of which they anastomose with the pancreatic ramifications of the ramulus gastricus inferior dexter. One of these ramuli, to the left extremity of the pancreas, is not unfrequently so much larger than the rest, that it has been denominated by some anatomists as the ramulus magnus pancreaticus.

(b.) *Ramulus gastricus inferior sinister* — when first separated from the splenic ramus, takes its course upwards and to the left of the great extremity of the stomach, behind which it is concealed: it then descends; and between the two layers of the great omentum, takes its course along the greater curvature of the stomach, to anastomose with the right inferior gastric ramulus. In its course it sends off small ramusculi to the pancreas, and ascending ramusculi to the anterior and posterior surfaces of the stomach, which anastomose with the descending ramifications of the ramulus inferior of the ramus coronarius ventriculi. Its descending ramusculi supply the left half of the great omentum, and the transverse arch of the colon.

(c.) *Ramuli breves.*—These are short vessels, separated from the splenic ramus just before it terminates within the spleen, and pass to the *cul de sac* of the stomach, which they supply; being directed upwards to the cardiac termination of the œsophagus, to anastomose with the œsophageal ramifications of the superior ramulus of the ramus coronarius.

The ramus splenicus then terminates by its ultimate distributions within the spleen.

(12.) *Arteria mesenterica superior*—is separated from the aorta not more than three or four lines distance below the celiac artery, and opposite to the first lumbar vertebra:

from hence it extends to the right iliac fossa, where it ter-
minates by supplying the cœcum. In this course it forms a
convexity facing to the left, and a concavity to the right. It
is first covered by the pancreas and vena portæ; then
emerging from the lower edge of the pancreas, it passes in
front of the third portion of the duodenum, behind the
transverse arch of the colon, and enters between the two
layers of the mesentery, to pass to its terminations.

To expose this artery in its whole course, the transverse
arch of the colon, with its mesocolon, must be turned up-
wards towards the thorax, when it may be seen passing from
under the pancreas; and in consequence of the transparancy
of the anterior layer of the mesentery, may be easily traced
in the remainder of its extent.

Immediately after the mesenteric artery is separated from
the aorta, it gives off some very small vessels to the duode-
num and pancreas, which anastomose with the splenic and
hepatic ramuli; after which, from its concavity, it sends off
the three following rami.

(A.) *Ramus colicus superior dexter*—arises from the
anterior and right portion of the mesenteric artery, while it
is covered by the transverse mesocolon, between the two
laminæ of which it insinuates itself, and runs forwards to
near the middle of the arch of the colon; but before it
reaches that intestine, it divides into a right and left
ramulus.

(a.) *Ramulus anastimoticus sinister* — accompanies the
left part of the transverse arch of the colon, as far as the
junction of the arch with the descending colon, where it
anastomoses with the ramus colicus superior sinister of the
inferior mesenteric artery. From the convexities formed by
these anastomoses, ramusculi pass off to supply the colon.

(b.) *Ramulus anastomoticus dexter* — is similar to the
last, but takes its course in an opposite direction, to anas-
tomose with the ramus colicus medius dexter, and in like
manner gives off ramusculi, which supply the correspond-
ing portion of the colon.

(B.) *Ramus colicus medius dexter*—arises generally about two inches below the last branch; sometimes, however, by a common trunk with it. It takes its course outwards, towards the ascending colon; but before it reaches it, divides into an ascending and descending anastomosing ramulus.

(a.) *Ramulus anastomoticus superior*—takes its course upwards, to anastomose with the right anastomotic ramulus, of the superior colic.

(b.) *Ramulus anastomoticus inferior*—takes its course downwards, to anastomose with the inferior right colic; both of them sending parallel ramusculi to the ascending colon from their convexities.

(c.) *Ramus colicus inferior dexter*—is the terminating branch of the superior mesenteric artery; it is directed between the two layers of the mesentery, to the junction of the ileum with the cæcum; just before it reaches this junction, however, it divides into three ramuli.

(a.) *Ramulus anastomoticus superior*—ascends to anastomose with the inferior anastomotic branch of the middle right colic.

(b.) *Ramulus anastomoticus inferior*—descends to anastomose with the termination of the superior mesenteric artery, and some of the branches from its convexity.

(c.) *Ramulus ileo colicus*—is the middle ramulus of the three; it runs from left to right to gain the posterior part of the colon and cæcum, where they are connected by the ileum—supplying the posterior parts of all these intestines.

(D.) *Rami mesentericæ.*—From the convexity of the superior mesenteric artery, from fifteen to twenty rami are given off, to supply all the small intestines excepting the two upper thirds of the duodenum. Their size and length diminish from above downwards; they are directed obliquely from right to left, and from above to below, between the two laminæ of the mesentery, toward the small intestines; before they reach them, however, they form numerous primary convexities, from which ramuli are distributed, that

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unite to form secondary convexities, from which ramusculi will sometimes form a third series of areolæ, before these vessels are finally distributed to the coats of the intestines.

(15.) *Arteria mesenterica inferior.*—This artery is separated from the aorta, much lower than the superior mesenteric artery, being not more than two inches from its division into the two iliacs, and opposite to the upper part of the fourth lumbar vertebra. It extends from that point deeply into the pelvis, where it terminates by supplying the rectum. In this course, like the superior mesenteric artery, it presents a concavity to the right, and a convexity to the left; but, unlike that vessel, it sends off its three principal branches from its convexity.

(A.) *Ramus colicus superior sinister*—is the largest of the three branches, and is usually separated from the inferior mesenteric artery, to the left side of the bifurcation of the aorta. It takes its course upwards, and having reached the anterior surface of the left kidney, it divides into two ramuli.

(a.) *Ramulus anastomoticus superior.*—This takes its course to the right, to anastomose with the ramulus anastomoticus sinister, of the superior colic ramus.

(b.) *Ramulus anastomoticus inferior* — descends, and unites in a similar manner, with the superior anastomotic ramulus, of the inferior left colic.

(B.) *Ramus colicus inferior sinister, vel sigmoideus*— directs itself outwards, and rather downwards to the left iliac fossa, to supply the sigmoid flexion of the colon ; when crossing the psoas muscle in this course, it frequently sends small ramuli to the ureter. Before it reaches the colon, it divides into a superior and an inferior ramulus; but sometimes also sends off a middle left colic ramulus.

(a.) *Ramulus anastomoticus superior*—passes to inosculate with the descending branch of the superior left colic.

(b.) *Ramulus anastomoticus inferior*—descends between the layers of the meso-rectum, and anastomoses with the superior hæmorrhoidal vessels.

(c.) *Ramus hæmorrhoidalis superior, vel internus*—is

irregular in its origin, being sometimes separated from the inferior mesenteric artery in two or three branches. It passes downwards, crossing the left sacro-iliac symphisis, the ureter, and the iliac vessels; and becoming deeper seated, passes between the layers of the meso-rectum, along the posterior surface of the intestine. At about the centre of the sacrum, it divides into two equally sized ramuli, which descend along the sides of the rectum, and then dividing into numerous ramusculi, are distributed to the coats of the rectum as far as the anus. In this course it anastomoses with the middle, and external hæmorrhoidal vessels.

The organs of digestion, and the chylopoetic viscera, being now removed, the remaining arteries of the abdominal aorta may conveniently be traced.

*Arteriæ phrenicæ*—are very irregular both in their origin and division, not unfrequently arising by a single vessel, which soon divides into a right and left phrenic; at others, the right is a branch from the cœliac artery; and again, three or four vessels will arise from the cœliac artery and aorta.

(9.) *Arteria phrenica dexter* — is given off from the aorta, immediately as it emerges from the crura of the diaphragm; it ascends outwards, behind the superior cava, and along the free edge of the crus of the diaphragm; and having gained the posterior edge of the cordiform tendon, it divides into an anterior and external ramus; before this division, however, it sends off small ramuli to the right crus of the diaphragm, and others to the renal capsules.

(A.) *Ramus anterior dexter*—passes forwards to the opening of the œsophagus, around which it inosculates with a similar branch of the left phrenic artery, and sends some ramuli upon the œsophagus, which anastomose with the œsophageal ramuli of the thoracic aorta. It also sends ramuli through the diaphragm, which supply the pericardium; while others supply the diaphragm itself, anastomosing with the superior diaphragmatic ramuli of the internal mammary.

(B.) *Ramus externus dexter*—is directed transversely outwards, above the right lobe of the liver, and takes its course along the ribs to supply the digital origins of the diaphragm from those bones; and terminates by anastomosing with the inferior intercostal, and superior lumbar arteries; it also sends some very small ramuli to the capsula renalis of its own side.

(10.) *Arteria phrenica sinister*—is generally given off from the aorta, and ascends outwards, crossing in front of the corresponding crus of the diaphragm, which it supplies; it sends branches to the œsophagus, which are here larger than upon the right side, and three or four small rami to the left capsula renalis; after which it divides into its anterior and external rami, just posterior to the aponeurosis of the diaphragm. The rami take their course in a corresponding direction to those of the opposite side, and require therefore no separate description.

(13.) *Arteriæ capsulares.*—These vessels are distributed to the capsulæ renales, in three distinct sets—a superior, a middle, and an inferior. The superior are ramuli, from the arteriæ phrenicæ; the inferior, from the arteriæ renales; but the middle set, which we are now about to describe, arise immediately from the aorta.

At the fœtal period of life, they are nearly as large as the renal arteries, and arise immediately above them; but at the adult period, they are comparatively small, and unimportant. As they pass outward from the aorta, crossing the crura of the diaphragm, they send some small rami to them, and to the psoas muscle, and terminate in the organization of the capsulæ renales.

(14.) *Arteriæ renales, vel emulgentes*—are of a large size, being computed to convey one-eighth of the whole of the blood to the kidneys. They are given off from the aorta, below the superior mesenteric artery, about opposite to the interspace of the second and third lumbar vertebræ. The right renal artery is generally a little lower than the left, and longer, having to pass behind the vena cava, being

covered by its corresponding vein. The left renal artery is a little more anterior than the right; and, like the right, is covered by its accompanying vein.

Before these arteries arrive at the kidneys, they send off—

(A.) *Rami capsulares inferiores.*—These are small vessels, which pass upward and outward, to the lower surface of the capsulæ renales, to which they are distributed.

The renal arteries then divide into three, four, or more rami, which approach the kidney between its pelvis, and the veins; but just as they enter the substance of the gland, they become anterior to the veins; where they subdivide, and are distributed to the parenchyma of the gland.

(15.) *Arteriæ spermaticæ*—in proportion to their length are the smallest, longest, and most tortuous arteries in the body. They are sometimes on both sides given off from the renal, more frequently on the right side only, but generally they are both given off from the aorta, above the inferior mesenteric artery, and below the renals, not usually upon the same level, but frequently at various distances one above the other. They take their course downward and outward, accompanied by their veins, and spermatic plexus of nerves; crossing the psoæ muscles, and the ureters,—to the outer side of which they descend, behind the peritoneum, to gain the internal abdominal ring; where, in the male, they become connected with the vasa deferentia, and assist in forming the spermatic cord in their descent to the testicle, where they terminate by dividing into two sets of rami— one of which goes to the epididymis, and the other to the bodies of the testicle, where they are finally distributed in the organization of the gland.

Where these vessels cross the ureters, they distribute small branches to the coats of those ducts.

In the female, the spermatic arteries arise as in the male subject, and take the same course into the cavity of the pelvis; instead of leaving which, they are received between the laminæ of the broad ligament of the uterus, to pass to the ovaria, into which they are finally distributed. One or

two small branches, however, take the course of the round ligament of the uterus, pass into the inguinal canal, and are distributed to the labia, and mons veneris.

(17.) *Arteriæ lumbales*—arise from the posterior and lateral parts of the aorta. There are usually five pair, but the fifth not unfrequently takes its origin from the common iliacs. These arteries resemble the intercostals in their distributions, and pass off transversely from the aorta. Soon after their origin, when opposite the transverse processes of the vertebræ, they divide into three sets of rami.

(A.) *Rami spinales*—pass through the intervertebral foramina to the spinal canal, and send off ramuli to the posterior parts of the vertebræ, which anastomose with each other, and with the second set of rami.

(B.) *Rami posteriores*—are the second set, and are distributed to the lumbar muscles of the back; anastomosing with each other, with the intercostal arteries, and with the ramuli spinales.

(C.) *Rami anteriores*—the third set, are the largest, and appear as the continuation of the main artery.

The anterior rami of the first pair, direct themselves outward over the body of the first lumbar vertebra, immediately beneath the last rib, in the direction of the external circumference of the diaphragm; they then pass downward, to be finally distributed in the transversi abdominalis muscles.

The anterior rami of the second pair, are distributed to the quadrati lumborum muscles.

The anterior rami of the third pair, are larger in size than the preceding; they pass between the quadrati lumborum, and transversi abdominalis muscles, directing themselves toward the crista of the ilium, at the posterior third of which, they divide into two ramuli—both of which penetrate the origin of the muscles from the ilium, and pass downward along the gluteal muscles, which they supply, and anastomose with the gluteal ramifications.

The anterior rami of the fourth pair, direct themselves

transversely outward, between the psoæ and quadrati lum-
borum, to pass to the crista of the ilium; where they divide
into ramuli, which pass over the ilium to anastomose with
the circumflexus ilii, and gluteal ramifications; and a branch
passes to the abdominal muscles, which are supplied by the
anterior ramusculi of all the anterior rami of the lumbar
arteries. The superior ones anastomose with the intercostals;
the inferior, with the ilio lumbar, and circumflexus ilii; and
the middle, with the internal mammary, and epigastric rami.

(18.) *Arteria sacra media*—is the last artery given off
by the abdominal aorta, before it divides into the two
common iliacs, usually from its posterior surface, above its
division, and opposite to the fourth lumbar vertebra; from
thence it extends to the extremity of the os coccygis. In
this course it passes in a tortuous direction along the centre
of the anterior surface of the sacrum, behind the rectum and
the superior hæmorrhoidal vessels. It gives off rami to the
rectum, sacrum, and muscles within the pelvis, and anas-
tomoses with the ilio lumbar, and lateral sacral ramuli of
the ramus iliacus internus; it also sends some small rami
through the anterior sacral foramina, to supply the spinal
marrow.

(19.) *Arteriæ iliacæ communes*—are the two large arte-
ries by which the abdominal aorta terminates. This bifur-
cation takes place at the intervertebral substance, between
the fourth and fifth lumbar vertebræ; from which the com-
mon iliacs extend, diverging as they pass downward, as far
as the sacro iliac symphysis, where they divide into the
external and internal iliacs. The common iliacs are of
equal size, separating from each other so as to form an
acute angle with respect to themselves, and each an obtuse
angle with the aorta.

From the greater breadth of the pelvis in the female than
in the male, these arteries are, in them, separated wider in
proportion. As their relative position differs with the surround-
ing parts, it will be necessary to describe them separately.

The *right common iliac artery*—is rather longer than the

left; and in its course to the sacro-iliac symphysis, it crosses
in front of the left common iliac vein, and the commence-
ment of the inferior cava. It is crossed by the ureter
anteriorly, and generally by the vermiform process of the
cæcum; to the right, it is bounded by the cæcum, and the
termination of the small intestines.

The *left common iliac artery*—descends with less obliquity
to its termination than the right; its accompanying vein is
internal, and posterior to it; the ureter and rectum cross it
in front; and the sigmoid flexure of the colon is placed to
its left. Neither of these arteries, before their division at
the sacro-iliac symphysis, send off any important branches;
some of a minute size may, however, be traced to the
peritoneum, glands, and muscles within the pelvis.

The common iliac arteries, are destined to supply the
pelvis, both externally and internally, as well as the whole
of the lower extremity: it is therefore divided, at the adult
period of life, into equally sized vessels; at which time,
the external iliac artery appears to be a continuation of the
main trunk; but if examined in the fœtal period of life,
the internal iliacs are the more important, and perform
the office of conveying the refluent blood to the mother,
when they seem to be the continuation of the main trunk.
Therefore we shall consider them both as continuations of
the common iliac arteries, numbering them the same; but
under the names they assume in the different situations they
pass through; in the same manner as we did the continuation
of the subclavian artery to the bend of the elbow.

(19.) *Arteria iliaca interna, vel hypogastrica.*—The im-
portant office which this artery performs in the fœtal circu-
lation, by conveying the blood to the placenta of the
mother, is the occasion of its comparatively large size at that
period. It takes its course from the division of each common
iliac, downwards and forwards, to the back part of the
bladder; from thence it ascends along the sides and superior
part of the fundus, takes the course of the urachus, and
passing between the peritoneum and fascia transversalis,

reaches the umbilicus, and constitutes part of the umbilical cord—with which it is continued to the placenta.

While within the abdomen, it gives off some very minute rami to the surrounding parts; on passing through the opening of the umbilicus, it decreases in size, winds around the umbilical vein, and near the placenta frequently inosculates with its fellow from the opposite side, before the two vessels ramify within the placenta.

After birth, these arteries not being longer required, are filled with a coagulum, and become obliterated; at the same time, the external iliac and its branches increase in size, until they bear the same proportion to the main trunk, which the internal iliacs had done during fœtal life.

The internal iliac in the adult subject, takes its course from the division of the common iliac, nearly vertically to the cavity of the pelvis, in front of the sacro-iliac symphysis, to gain the sciatic notch, where it terminates by dividing into numerous rami. In this course it makes a curve with a concavity facing forwards.

The rami given off from this artery, may be divided into three sets: those which supply the muscles within the pelvis; those which supply the viscera within the pelvis; and those which pass out of the cavity of the pelvis.

As the dissection of these vessels is attended with some difficulty, a side view of the pelvis should be made, in order to expose them most conveniently.

The rami which supply the muscles within the pelvis, are two in number.

(A.) *Ramus ilio lumbalis*—arises from the posterior part of the internal iliac artery, in front of the sacro-iliac symphysis. It takes its course first upwards, then outwards behind the psoas and iliacus muscles; anterior to the communicating branch of the last lumbar nerve, and posterior to the anterior crural nerve, and external iliac artery and vein. Having reached the upper part of the sacro-iliac symphysis, it divides into three sets of ramuli.

(a.) *Ramulus ascendens*—behind the psoas and iliacus

muscles, rises upwards upon the os ilium, as high as the posterior and superior spinous process, where it anastomoses with the inferior lumbar arteries; and some few ramusculi pass into the intervertebral foramina, to assist in supplying the spinal marrow; and, finally, it is distributed to the psoas, iliacus, and quadratus lumborum muscles.

(b.) *Ramulus descendens*—takes its course downwards, underneath the psoas and iliacus muscles; and descending in the substance of these muscles to the crural arch, anastomoses there with the epigastric rami of the femoral artery.

(c.) *Ramulus externus*—takes its course outwards upon the venter of the ilium, under the iliacus muscle; supplying both with blood, and passing outwards to the crista of the bone, terminates by anastomosing with the ramus circumflexus ilii, arteriæ femoralis.

(B.) *Ramus sacri lateralis.*—This branch is irregular, both as to its origin and number; arising, sometimes by three or four small vessels, at others in a single branch, commonly from the internal iliac, but occasionally from the ilio lumbar, or the gluteal ramus. When it arises in a single branch, it is directed downwards and inwards, along the anterior surface of the sacrum, external to the middle sacral artery; and converging in its descent as far as the os coccygis, it anastomoses with the corresponding ramus of the opposite side, and with the middle sacral artery. In this course, it crosses anterior to the pyriform muscle, and sacral nerves; the sympathetic nerve is placed to its inner side, between it and the middle sacral artery—it divides into two sets of ramuli.

(a.) *Ramuli posteriores*—are four or five in number, which pass into the anterior sacral foramina, and there divide into two sets of ramusculi—the exterior to supply the spinal marrow, and its membranes; while the posterior emerge from the spinal canal, through the posterior sacral foramina, and terminate by being distributed to the neighbouring deep-seated muscles of the back.

(b.) *Ramuli interni*—are far less important than the

preceding ramuli; they pass inward upon the anterior surface of the sacrum, and terminate by anastomosing with the branches of the middle sacral artery.

The branches to the viscera within the pelvis, are—

(c.) *Ramus hæmorrhoidalis medius.*—This ramus varies much, both in size and origin, and is even occasionally entirely wanting. Although it sometimes arises from the ischiatic or pudic rami, it most frequently comes from the internal iliac artery. It takes its course downwards, forwards, and inwards, upon the anterior surface of the rectum, between it and the bladder, in the male, but between it and the vagina, in the female; in either of these situations it divides into superior and inferior ramuli: the superior anastomosing with the internal hæmorrhoidal ramus of the inferior mesenteric artery; and the inferior anastomose with the external hæmorrhoidal ramulus of the internal pudic ramus. It also supplies, in both sexes, parts of the organs of generation; namely, the prostate gland, and vesiculæ seminales, in the male, and the vagina and uterus, in the female.

(d.) *Rami vesicales.*—The bladder receives its blood from three distinct sources, the vessels may therefore be arranged in three sets; the superior, from the umbilical branch, from which point, that vessel is obliterated after birth; the inferior from the hæmorrhoidal, internal pudic, and sciatic branches; but the middle set, are the rami vesicales, which we are now about to describe, as they most generally arise from the internal iliac, and sometimes only by one single vessel.

From its origin, it passes forwards, accompanying the ureter, until it reaches the bladder; where it divides into numerous ramuli, supplying the under surface of the bladder; and in the male, distributing itself to the prostate gland, vesiculæ seminales, vasa deferentia, and commencement of the urethra.

(e.) *Ramus umbilicalis.*—This vessel assumes a very different character after the fœtal period. Before birth, it is a large branch, and seemingly a continuation of the internal iliac artery; and runs upwards to the umbilicus, in a manner

which has already been described in its passage to the placenta.
After birth, the whole vessel diminishes very much in size,
but still conveys some small quantity of blood as far as the
bladder; beyond which, it assumes the appearance of an
impervious cord—described by some anatomists, as a liga-
ment of the peritoneum.

(F.) *Ramus uterinus.*—The size of this artery depends
upon the age of the individual, and the state of develope-
ment of the uterus; increasing with the size of that organ
during uterine gestation, until it becomes the largest of the
branches of the internal iliac. It it various in its origin,
being sometimes given off from the internal pudic; it directs
itself forwards to the upper part of the vagina, and passing
between the two layers of the broad ligament in a very
tortuous course, it reaches the uterus: here it divides into
numerous ramuli, which ramify through the parietes of the
uterus, anastomosing in its substance with the other vessels
of that organ.

This ramus also supplies in part the bladder and vagina;
and while between the broad ligaments, it sends ramuli to
the fallopian tubes and ovaria; anastomosing with the sper-
matic artery from the abdominal aorta.

(G.) *Ramus vaginalis*—is very various in its origin, and is
sometimes wanting, when the vagina is supplied by ramifi-
cations from the branches of other arteries proportionably
increased in size. Arising from the internal iliac, it directs
itself forwards to the lateral surface of the bladder, to which
it sends some small ramuli; then reaching the side of the
vagina, it ramifies on its parietes, proceeding as far as the
external organs of generation, in which it terminates.

The third set of the ramuli of the external iliac, and
which pass out of the pelvis, are—

(H.) *Ramus obturatorius.*—This vessel, like the branches
already described of the internal iliac, is various in its
origin; sometimes springing from the gluteal, ischiatic, or
epigastric branch of the femoral artery: the latter, although
not uncommon, must be considered curious from its altering

entirely the course of the vessel, and rendering its patholo-gical consideration highly important, particularly as connected with femoral hernia.

When it arises from the internal iliac, it passes forwards and downwards along the linea ilio pectinea, on the inner side of the psoas and iliacus muscles, and above the levator ani, until it reaches the upper edge of the obturator internus muscle, which it penetrates, and then passes through the obturator ligament, to descend into the thigh. The vessel in this course is accompanied by a corresponding nerve, which is anterior to it. While within the pelvis, the obturator artery gives off—

(a.) *Ramuli interni*—which are distributed to the absorbent glands, situated around the iliac vessels; and also supply the psoas, iliacus, levator ani, and obturator internus muscles. The bladder, and organs of generation within the pelvis, frequently receive ramuli from the obturator ramus.

Just before it passes through the obturator ligament, it sends a ramulus along the inner edge of the obturator foramen, which passes upwards towards the symphisis pubis, and inosculates with a similar branch of the opposite side: from which union ramusculi pass upwards upon the abdominal muscles, and anastomose with the epigastric ramus. As soon as the obturator ramus leaves the pelvis, it sends off its—

(b.) *Ramuli externi*—which divide into two sets of ramusculi. The first of these pass downward and outward, along the outer margin of the obturator foramen: and winding beneath the acetabulum, between it and the tuberosity of the ischium, divide into several ramifications, to supply the obturator externus muscle, and to pass through the cotyloid foramen into the interior of the joint to the capsular ligament: they also supply the numerous posterior muscles of the thigh, among which they anastomose with the internal circumflex ramulus of the ramus profundus, and with the ischiatic and pudic rami of the internal iliac artery.

The second external ramulus takes its course backwards and inwards, under the obturator externus muscle, to the inner margin of the obturator foramen, where it is covered by the obturator externus, pectineus, and adductors of the thigh, and then divides into numerous muscular ramusculi, anastomosing with the internal circumflex branch of the ramus profundus. Some of its ramusculi penetrate the adductor muscles; and passing to the perineum and scrotum, anastomose with the internal pudic ramus of the internal iliac artery. Some other ramusculi pass downward, beneath the gracilis, and adductor longus muscles, and inosculate with the perforating ramuli, of the ramus profundus, of the femoral artery.

(1.) *Ramus gluteus vel iliacus posterior*—is the largest of the branches from the internal iliac artery. It takes its course outwards, downwards, and backwards, above the pyramidal muscle, to pass out of the great sciatic notch, being accompanied by its corresponding vein, and superior gluteal nerve. At its origin it is covered by the internal iliac artery and vein, and by a communicating branch of the last lumbar, and first sacral nerve. When it has passed out of the notch, and gained the dorsum of the ilium near the posterior edge of the gluteus minimus muscle, it terminates by two ramuli. While the ramus gluteus is within the pelvis, it but rarely distributes any important branches; but sometimes the ilio lumbar, lateral sacral, and middle hæmorrhoidal ramus arise from it. Where it passes through the ischiatic notch, it distributes a few ramuli to the pyriform muscle; and while on the dorsum of the pelvis, covered by the gluteus maximus, it divides into its two terminating ramuli, by which it performs its most important office.

(a.) *Ramulus superficialis.*—To expose this vessel, the gluteus maximus must be raised, when it will be seen directing itself outwards, between the gluteus maximus, and gluteus medius muscles, and separating into numerous ramusculi, some of which supply the glutei muscles, others pierce the posterior sacro sciatic ligament, to ramify on the

back part of the sacrum, and os coccygis, and anastomose
with the ramuli of the pudic, sciatic, and lateral sacral
rami.

(*b.*) *Ramulus profundus*—is larger than the preceding.
It passes upwards and forwards, between the gluteus me-
dius and minimus; and having sent off—

(*α.*) *Ramusculus nutritius* — to the ilium, immediately
divides into three sets of ramusculi.

(*β.*) *Ramusculi superiores*—usually two or three in num-
ber—take their course forward, along the upper convex edge
of the gluteus minimus muscle, and continue as far as the
anterior superior spinous process of the ilium, where they
terminate by anastomosing, with the circumflex ramuli of the
femoral artery; but in their course they send ramifications
to the gluteus medius, and gluteus minimus muscles, and
anastomose with the ilio lumbar, and circumflex ilii rami.

(*γ.*) *Ramusculi medii*—usually two vessels, take their
course downward, and outward, toward the trochanter major,
crossing the centre of the gluteus minimus, in the direction
of the fibres of that muscle. They are covered by the
gluteus medius, which they supply with ramifications, as
well as the gluteus minimus; and terminate by anastomos-
ing, underneath the tensor vaginæ femoris muscle, with the
external circumflex ramuli, of the femoral artery.

(*δ.*) *Ramusculus inferior* — or descending ramusculus,
passes downwards in the same course as the last described;
but is deeper seated, as it perforates the gluteus minimus
muscle, and lies upon the dorsum of the ilium. It then
passes forwards, above the acetabulum, to the anterior and
inferior spinous process of the ilium, where it terminates as
the others, by anastomosing with the external circumflex
ramulus of the femoral artery. It also supplies the gluteus
medius and minimus muscles, and origin of the rectus.

The frequent anastomosis of the ramifications of the glu-
teal ramus from the internal iliac, with the circumflex ramuli
of the femoral artery, renders this vessel highly important in
obliterations of the external iliac artery.

(κ.) *Ramus ischiadicus*—arises from the internal iliac artery, rather anterior to the separation of the gluteal ramus. It is smaller than that ramus, although more like a continuation of the artery from which it arises. It passes vertically downwards, in front of the pyriform muscle, between the inferior edge of which, and the anterior sacro-sciatic ligament, it passes out of the sciatic notch, in front of the sciatic nerve, and terminates by ramuli to the back part of the ilium and thigh. While within the pelvis, this ramus sometimes distributes ramuli to the viscera contained within the cavity, but this is very variable. As soon as it passes out of the pelvis, it is covered by the gluteus maximus muscle, and descends between the trochanter major, and tuberosity of the ischium, but nearer to the latter, and terminates in the back part of the thigh, by supplying the muscles of that region. In the above course it distributes three ramuli.

(a.) *Ramulus coccygeus*—is a vessel of considerable size. It directs itself obliquely inwards, across the external pudic artery, which is anterior to it, perforates the origin of the sacro-sciatic ligaments, to gain the os coccygis and sacrum, where it anastomoses with the posterior ramuli, of the lateral sacral ramus.

(b.) *Ramulus comes nervi ischiadici*—as its name implies, takes its course with the ischiatic nerve as far as the inferior part of the thigh: in this course anastomosing frequently with the branches of the femoral artery.

(c.) *Ramuli musculares*—are separated from the ischiatic in the fossa between the tuberosity of the ischium and the trochanter major, and immediately divides into numerous ramusculi, to supply, anteriorly, the gemini, obturator internus, and quadrator femoris muscles, and anastomose with the circumflex ramuli of the ramus profundus; externally, the glutei at their insertion into the trochanter major; and inferiorly and internally, the biceps, semi-membranosus, and semi-tendinosus muscles, and anastomosing with the perforating ramuli of the ramus profundus. The ramus ischiadicus also assists in conveying blood from the internal iliac to the

lower extremity, in cases of obliteration of the external iliac artery.

(L.) *Ramus pudicus internus*—generally arises from the internal iliac artery, immediately after the separation of the ramus ischiadicus; but the two will sometimes arise in common; in which case, they may not separate into two branches, until the common branch has passed out of the pelvis. When it arises separately from the internal iliac, it descends vertically in front of the ischiatic nerves and pyramidal muscle, and passes out of the pelvis below the inferior edge of the pyramidal muscle, accompanied by the ischiatic artery, which is anterior and internal to it.

In the second part of its course, it is placed between the pyramidal muscle and the posterior sacro-sciatic ligament, on the dorsum of the pelvis, forming an arch, the concavity of which embraces the spinous process of the ischium, and insertion of the anterior sacro-sciatic ligament.

In the third portion of the course of this ramus, it re-enters the pelvis, between the two sacro-sciatic ligaments, running forwards on the inner side of the tuberosity and ramus of the ischium and pubis, as far as the symphysis pubis, where it terminates by dividing into two ramuli.

In the first part of the course of the ramus pudicus internus, namely, while within the pelvis, it sometimes gives off the ramus hæmorrhoidalis medius, but always small ramuli to the bladder and organs of generation, both in the male and female.

In the second part of its course, namely, while exterior to and on the dorsum of the pelvis, it distributes small ramuli to the sacro-sciatic ligaments, to the tuberosity of the ischium, to the sacrum, to the os coccygis, and to the muscles arising from the bones; it also anastomoses with the ischiatic and gluteal rami. This portion of the artery is covered by the gluteus maximus muscle.

In the third part of its course, namely, where it re-enters the pelvis, this ramus is of great practical importance. It first lies between the obturator internus muscle, which

separates it from the bone, and the junction of the obturator
fascia with the sacro-sciatic ligament, which excludes it from
the cavity of the pelvis; it then proceeds forwards, along
the ramus of the ischium and pubes, to the triangular liga-
ment, where it terminates.   In this course it sends off—

(a.) *Ramuli hæmorrhoidales externi*—are usually sepa-
rated from the external pudic ramus directly it has re-entered
the pelvis: they pass inward, penetrating the obturator fas-
cia, and then only are properly within the cavity: they here
supply the levator ani muscle, and some of them perforate
it, to supply the sides of the rectum, and anastomose with
the ramus hæmorrhoidalis medius of the external iliac artery.

(b.) *Ramulus perenæi* —Takes its course forwards, to
perforate the deep fascia of the perinæum, which in fact is
continuous with the obturator fascia of either side, reaching
across from the rami of the ischium and pubis of one side, to
the other.   After perforating this fascia, it is placed within
the perinæum, and continues its course forwards and inwards
towards the symphysis pubis: having to its outer side the
erector penis, and on its inner side the accelerator urinæ
muscle.

In the first part of this course, it is very deeply seated,
and is nearer to the tuberosity of the ischium than to the
centre of the perinæum; but as it advances, it becomes
more superficial, and approaches the mesian line.   In this
extent it sends off internal ramusculi, to supply the muscles
of the perinæum, and to anastomose with the corresponding
ramulus of the opposite side. . It sends also external ramus-
culi around the rami of the ischium and pubes, to anasto-
mose with branches of the femoral artery, upon the inner
side of the thigh; and it terminates anteriorly, by small
ramusculi, which supply the scrotum.   The whole course of
this ramulus, is accompanied by a branch of the internal
pudic nerve.

(c.) *Ramulus transversalis perinæi*—is smaller than the
last described vessel, and is indeed very frequently a ra-
musculus from it.   When arising from the internal pudic, it

is anterior to the ramulus perinæi, and perforates the deep
fascia of the perinæum, passing as far forwards as the trans-
versus perinæi muscle; having gained which, it runs upon
the under surface of that muscle inwards towards the mesian
line, where it anastomoses with the corresponding ramulus
of the opposite side; posteriorly, with the external hæmor-
rhoidal ramulus; and anteriorly, with the perineal.

(*d.*) *Ramulus corporis bulbosi, vel spongiosi urethræ*—
is a larger vessel than any of the other ramuli of the pudic
ramus, but takes a much shorter course; it does not, like
the ramuli of the perinæum, perforate the deep fascia, but
passes within the anterior layer of that membrane, as it
passes forwards to cover the membranous portion of the
urethra and bulb. When the ramulus reaches the bulb, it
divides into two ramusculi; the smaller of them descends a
little to supply Cowper's gland of its own side; while the
largest enters the bulb, and supplies it, and the corpus
spongiosum urethræ. It is this vessel which frequently leads
to fatal hæmorrhage, after the operation of lithotomy.

(*e.*) *Ramulus corporis cavernosi penis*—is one of the
vessels by which the internal pudic terminates, after it has
perforated the triangular ligament of the pubes, and is
placed between the bone and the crus of the penis. This
ramulus enters the crus penis, and runs through it into the
corpus cavernosum of its own side, where it divides into
numerous ramusculi, which open into the cells of the organ.
Some of them anastomose in the mesian line, passing
through the septum to the corresponding vessels of the
opposite side; others supply the lining membrane of the
urethra.

(*f.*) *Ramulus dorsalis penis*—appears like a continuation
of the internal pudic ramus; it takes its course outside the
crus, between it and the ramus of the pubes; and running
superficially under the integuments, accompanied by its
corresponding vein and nerve, it approaches the ramulus of
the opposite side, running in a groove upon the dorsum of
the penis, as far as the corona glandis, where the two ramuli

inosculate. In this course it sends off ramusculi to the scrotum, and to the skin and fascia of the penis. At the earlier periods of life, the internal pudic ramus and its divisions bear but a small proportion to their developement at the adult period.

(19.) *Arteriæ iliacæ externæ*—are continuations of the common iliac arteries, as are the internal iliacs, to which they bear a proportionable size, differing at different periods of life. If examined at the adult period, they are found larger than the internal iliacs, and seem to be a continuation of the common iliacs; while, as has been already stated, before birth they are small and comparatively unimportant vessels. The extent of the external iliac arteries, is from the sacro-iliac symphysis to the lower edge of Poupart's ligament, from whence they change their name, being successively denominated femoral, and popliteal, from the regions through which they pass. The course, boundaries, and distribution of each external iliac, are so precisely similar, that the description of one will serve for both.

In the passage from their separation to their termination at Poupart's ligament, they descend obliquely outward, along the inner edge of the psoas muscle, to which they are loosely connected by a portion of the fascia iliaca; this fascia also unites the arteries with their corresponding veins, which are placed to their inner side, and rather posterior to them above; but on the same plane with them below, as they pass over the pubes. They have also behind them the psoas, and the tendinous portion of the iliacus muscle; in front, the peritoneum, and a branch of the external spermatic nerve; and on their outer side, the anterior crural nerve, which is, however, on a plane posterior to them, being behind the fascia iliaca, while the arteries are in front.

In this course, the external iliac artery is sometimes curved: it sends off some small rami, to be distributed to the psoas and iliacus muscles, and the deep inguinal glands; they are however, small and unimportant compared to the two following rami.

(A.) *Ramus epigastricus*—is sent off from the inner side of the external iliac artery, usually close to the external abdominal ring, but behind the fascia transversalis, between it and the peritoneum. The variations in this origin, are, that it is sometimes given off an inch above Poupart's ligament; at others, immediately at its lower edge: in the former case, the vessel descends first, before it can turn up in front of the peritoneum; but in the latter, it immediately ascends.

This ramus extends from a little to the inner side of the centre of Poupart's ligament to the umbilicus, crossing behind the spermatic cord, from which it is separated by the fascia transversalis. The vas deferens, however, having reached the internal ring, leaves the spermatic cord, and passes behind the epigastric artery to reach the prostate gland.

When the ramus epigastricus reaches the rectus muscle, midway between the pubes and umbilicus, it perforates the sheath of the rectus, and then becomes separated from the peritoneum. In this course, it frequently gives off the ramus obturatorius, which has then to pass backwards and inwards to gain the obturator foramen; under which circumstance, should a femoral hernia pass down behind it, and become strangulated, in the separation of the stricture, it must almost necessarily be divided, in the event of an operation.

It sends off ramuli, which penetrate the fascia transversalis to gain the inguinal canal, to supply the cremaster muscle and tunica vaginalis, anastomosing with the spermatic arteries. In the female, these ramuli take the course of the round ligament of the uterus. As the ramus epigastricus ascends, it sends off numerous ramuli externally, to supply the abdominal muscles; and anteriorly, through the tendon of the external abdominal oblique, to supply the skin and fascia, anastomosing with the external epigastric of the femoral artery: lastly, when it has reached the sheath of the rectus, it sends some ramuli upward, to anastomose with the internal mammary ramus of the subclavian artery; and

inward, to anastomose with the corresponding ramus of the opposite side ; and outward, to anastomose with the lumbar arteries and ramus circumflexus ilii.

· (B.) *Ramus circumflexus ihi*—is usually smaller than the preceding branch, and is sent off lower down from the external side of the external iliac. It ascends upwards and outwards, crossing the iliacus and psoæ muscles to gain the crista of the ilium ; having reached which, it divides into two ramuli, one external and one internal.

(a.) *Ramulus anterior*—ascends between the transversalis and internal abdominal oblique muscles, to be distributed to them.

(b.) *Ramulus posterior*—is the larger, and take its course along the inner labium of the crysta of the ilium, over which it anastomoses with the superficial ramuli of the ramus gluteus ; it still continues its course backwards and upwards to terminate in the abdominal muscles, anastomosing with the ilio lumbar, the lumbar, inferior intercostal, and internal mammary vessels.

(19.) *Arteria femoralis*—commences from the external iliac, immediately as it emerges from the lower edge of Poupart's ligament ; and extends to the junction of the middle with the inferior third of the thigh, at the point where the adductor magnus muscle becomes tendinous, through which it passes, and is then named the popliteal artery. In this course, the femoral artery may be divided into an upper and a lower half ; the former being placed superficially, and in front ; and the latter deeply seated, and on the inner side of the thigh ; from which it results, that its course is oblique from above downwards.

The superior half is covered by integuments, superficial fascia, absorbent glands, and the fascia lata. It lies upon the pectineus, adductor brevis, and adductor longus muscles ; from the two former, however, it is separated by an interval of cellular membrane, excepting in certain positions of the thigh. It is bounded, externally and above, by the anterior crural nerve ; then by the tendons of the psoas and iliacus,

which separate it from the hip-joint; and below this, by the vastus internus muscle, and sartorius—which are, however, at some distance from it. Internally, it has to its inner side above, the femoral vein; but which, as it descends, gets behind the artery.

The femoral artery commences its lower half, where the sartorius muscle crosses it and the adductor longus, forming the apex of a triangle, in the centre of which the upper half of the femoral artery is placed. The lower portion of the artery is covered by the skin, fascia lata, and sartorius muscle; behind which will be found a fascia, common to the vastus internus and adductor longus muscles, in which the artery, vein, and the nervus saphenus are enclosed. Posteriorly, it is bounded by the conjoined tendons of the vastus internus and adductor muscles; externally, by the vastus internus; and internally, by the adductor magnus. The branches which are sent off from the upper half of the femoral artery, are four in number—three of which are superficial, and one deep.

(A.) *Ramus epigastricus superficialis*—arises about half an inch below Poupart's ligament; it almost immediately penetrates the fascia lata, ascends above Poupart's ligament, taking the direction of the internal epigastric artery, but being merely subcutaneous. It extends from below Poupart's ligament, nearly to the umbilicus, where it terminates by anastomosing with small branches of the deep epigastric, and internal mammary rami. In this course, immediately after its origin, it supplies the inguinal glands; and having reached the abdomen, it there supplies the skin, and the abdominal muscles.

(B.) *Ramus pudicus superficialis*—usually two in number, a superficial, and a deep branch; but often it arises by a common vessel, which afterwards divides.

(a.) *Ramulus superficialis*—takes its course upwards and inwards to the pubes, to supply the external organs of generation in both sexes, and to anastomose with ramusculi of the internal pudic.

(b.) *Ramulus profundus*—which is sometimes sent off from the ramulus circumflexus internus, takes its course in a transverse direction, behind the fascia lata, and in front of the pectineus muscle, to gain the perinæum, in which it terminates, anastomosing with the ramus pudicus internus.

(c.) *Ramus circumflexus ilii superficialis*—is much smaller than either of the other branches; and although pretty constant in its origin and course, is not particularly described by anatomists. Immediately after its origin it pierces the fascia lata, takes its course outwards, along the under edge of Poupart's ligament, as far as the spinous process of the ilium; where it divides into numerous ramuli, to supply the parietes of the abdomen, and to anastomose with the deep circumflexus ilii, gluteal, and external circumflex rami.

(D.) *Ramus profundus femoris*—is separated from the posterior part of the femoral artery, usually about an inch and a half below Poupart's ligament; and in a space midway between the pubes and trochanter minor; from hence it passes downwards and backwards, to about the middle part of the thigh; where perforating the aponeurosis of the adductor longus, it gains the posterior part of the thigh, and terminates in three or four muscular ramuli.

In this course, the ramus profundus is first directed slightly outwards from the femoral artery, lying on the psoas and iliacus muscles; it then descends in front of the insertions of the pectineus and adductor brevis, and perforates the adductor longus, as before stated. It has in front of it, in the first part of its course, where it is directed outwards from the femoral artery, only the fascia lata and common integuments; but as it descends, it is covered by the femoral artery and vein, with which it runs parallel for some distance, but much deeper seated.

Five ramuli are sent off from the ramus profundus, which have distinct names; besides others, which are of less importance.

(a.) *Ramulus circumflexus externus* –is given off while

the ramus profundus is to the outer side of the femoral artery; it is directed transversely outwards, and is a large short vessel, passing behind the rectus and sartorius muscles, and crossing in front of the psoas, iliacus, and crureus, where it is divided into three sets of ramusculi.

(*a.*) *Ramusculi ascendentes*—are three or four in number, which run upward, behind the sartorius and tensor vaginæ femoris, and then between that muscle and the gluteus medius and minimus; anastomosing with the ramusculi inferiores, of the gluteal ramus; and terminate by supplying the neighbouring muscles.

(*β.*) *Ramusculi transversales*—are two or three in number, and continue in the direction of the main ramulus, passing still farther to the outer of the crureus muscle, as far as the origin of the vastus externus muscle, where they perforate it and the insertion of the gluteus maximus; and gain the posterior part of the thigh, below the trochanter major, where they terminate by supplying the muscles, and anastomosing with the ramulus circumflexus internus, and the gluteal and ischiatic rami.

(*γ.*) *Ramusculi descendentes*—are large and numerous they pass downward, between the crureus and vastus externus muscles, and extend to the outer side of the knee-joint, where they terminate by anastomosing with the articular ramuli of the popliteal artery. They also supply the rectus, crureus, and vastus externus; in their course anastomosing, posteriorly, with the perforating ramuli of the ramus profundus.

(*b.*) *Ramulus circumflexus internus*—is usually larger than the preceding ramulus, and is given off below it. It takes its course backwards and inwards, between the pectineus and the tendinous insertion of the psoas and iliacus muscles; it then continues its course around the neck of the femur, between the inferior edge of the quadratus femoris and the superior edge of the adductor magnus, where it divides into two terminating ramusculi. In this course, the ramulus gives off small ramusculi to the neighbouring muscles, the

capsular ligament, and others anastomosing with the ramus obturatorius; they together supply the interior of the hip-joint.

(*α.*) *Ramusculus ascendens*—is separated in the space between the quadratus femoris and adductor magnus, and is covered, posteriorly, by the gluteus maximus. It then arises outwards, along the obturator externus muscle, to gain the digital cavity of the great trochanter, where it terminates by supplying the outer rotators of the thigh, and anastomosing with the gluteal and external circumflex ramuli.

(*β.*) *Ramusculus descendens*—is rather the larger of the two, and takes a transverse course downwards, dividing into two sets of ramifications; one set passing inwards to the tuberosity of the ischium, supplying the origin of the muscles of the ham-strings; the other passing downwards in the course of the sciatic nerve, to terminate by supplying the adductor magnus muscle, and anastomosing with the gluteal ischiatic rami, and the superior perforating ramusculus of the ramus profundus.

The frequent anastomoses of the circumflex ramuli with the gluteal, ischiatic, pudic, and obturator rami of the internal iliac artery above; and with the articular rami of the popliteal artery below, is the principal means of carrying on the circulation, in obliterations of the external iliac.

(*c.*) *Ramulus perforans primus*—is sent off from the ramus profundus, opposite to the trochanter minor; it takes its course backwards, below the tendon of the pectineus; and passing between the adductor longus and the adductor brevis, it perforates the adductor magnus, where it terminates in numerous ramusculi. In this course, it supplies the pectineus, and adductor muscles; afterwards the gluteus maximus and biceps; anastomosing, above, with the ischiatic, and gluteal rami, and the circumflex ramuli of the ramus profundus; and below, with the inferior perforating ramusculi,

(*d.*) *Ramulus perforans secundus*—is sent off immediately below the preceding ramulus, and directly perforates

the adductor brevis, and then. the adductor magnus, to gain
the back part of the thigh ; where it. divides into ascending
ramusculi, to supply the gluteus maximus muscle, and to
anastomose with the ramulus perforans primus; and de-
scending ramusculi, which supply the biceps, semi-mem-
branosus, semi-tendinosus, and triceps muscles; and to
anastomose with the ramulus perforans tertius. It sends
also a ramusculus nutritius into the former; the foramen for
which is directed from below upwards, and is usually found
at about the junction of the upper with the middle third of
the femur, in the course of the linea aspera.

(e.) *Ramulus perforans tertius*—is the smallest of the
three ramuli, and is separated much lower down than the
others. It passes to the back part of the thigh, perforating
the adductor magnus, and immediately dividing into nu-
merous ramusculi, which superiorly anastomose with the
other perforating ramuli, inferiorly with the articular rami
of the popliteal artery; and terminates by supplying the
surrounding muscles.

(E.) *Ramus anastomoticus magnus*—is separated from
the femoral artery, just where it enters the tendinous sheath
formed for it by the tendons of the triceps and vastus ex-
ternus muscles. It immediately perforates this fascia, and
takes its course inwards, along the vastus internus, towards
the inner condyle of the femur, where it divides into nu-
merous ramuli; inferiorly, anastomosing with the articular
rami of the popliteal artery, and with the recurrent branch
of the anterior tibial ramus; superiorly, anastomosing with
the ramusculi perforantes; and anteriorly, behind the ex-
tensor tendon of the knee-joint, with the descending ramus-
culi of the external circumflex ramulus.

(19.) *Arteria poplitea*—is so termed immediately the
femoral artery emerges from the fascial sheath formed by the
adductor magnus and vastus internus muscles; from this it
passes obliquely downwards and outwards, to the lower edge
of the popliteus muscle, where it terminates by dividing into
two rami.

It may be observed, when taking a general view of the course of the femoral and popliteal arteries in the thigh, that the first third of this course is anterior, the middle third internal, and the lower third posterior, to the thigh-bone.

The lower third, or popliteal artery, is bounded, above, anteriorly by the femur; in the middle, by the posterior surface of the knee-joint; and below, by the popliteus muscle. Posteriorly, it is bounded by the popliteal vein, which is rather external to it, and by the sciatic nerve, which is still more superficial and external to it; above, by the semi-membranosus muscle; and below, by the heads of the gastrocnemii. It is here also crossed by the posterior tibial nerve. It has to its outer side, the biceps, external head of the gastrocnemius, and origin of the plantaris muscle : the gastrocnemius forms its internal boundary. In this course, the popliteal artery sends off numerous small muscular branches above, to supply the muscles in the lower and back part of the thigh; and to anastomose with the perforating ramuli of the ramus profundus. These vessels have, however, no distinct names. Besides the above, the popliteal artery gives off five rami, which are more important; and supply the knee-joint; and then ultimately terminate, by sending off inferior muscular branches.

(A.) *Ramus articularis superior internus.*—The precise point at which this ramus is separated from the popliteal, is very various, and may occur at any part of the distance from where it penetrates the adductor magnus, to the internal condyle. It reaches its course inwards, behind the vastus externus and adductor muscles, close upon the bone; passing forwards, above the internal condyle of the femur; and anastomoses with the ramus anastomoticus magnus, and the ramus articularis externus. It also sends some ramuli downwards, in the direction of the tendon of the adductor magnus, to anastomose upon the inner side of the knee-joint with the inferior articular ramus.

(B.) *Ramus articularis superior externus*—arises from the outer side of the popliteal artery, and proceeds immedi-

ately outwards, close to the bone, behind the tendon of the
biceps, winding around the femur above the external con-
dyle; and having gained the fore part of the femur, it
divides into two ramuli. The superior, or deep-seated, takes
its course upwards, to supply the periosteum and muscles
on the fore part of the thigh, and anastomoses with the
muscular rami of the femoral artery. The superficial and
anterior ramulus passes forwards, above the external condyle
of the femur, through the vastus externus muscle, to gain
the patella, upon which it anastomoses with the internal
superior articular ramus.

(c.) *Ramus articularius medius, vel azygos*—is much
smaller than the two preceding rami, and passes forwards
through the posterior ligament of Winslow, to gain the
interior of the knee-joint, where it divides into two ramuli;
one of which remains external to the synovial membrane,
and supplies the adeps and cellular membrane at the back
part of the joint; the other distributes itself to the synovial
membrane, the crucial ligaments, and the interior parts of
the joint.

(d.) *Ramus articularis inferior internus*—arises from
the outer side of the popliteal artery, immediately above the
popliteus muscle, and takes its course inwards in front of
the posterior tibial nerve and gastrocnemius externus mus-
cle, between them and the head of the tibia, around which
it runs, behind the internal lateral ligament of the knee-joint,
and the tendons of the sartorius, gracilis, and semi-tendinosus
muscles; having reached the fore part of the tibia, it runs
up the inner edge of the ligamentum patellæ, to gain the
bone; and upon it anastomoses with the superior inner
articular, and inferior external articular rami.

(e). *Ramus articularis inferior externus*—arises from the
outer side of the popliteal artery, below the knee-joint, but
above the head of the fibula. It takes its course outwards,
along the convexity of the external semilunar cartilage;
covered, in its course, by the gastrocnemius externus, plan-
taris, external ligament of the knee-joint, and tendon of the

biceps ; then having gained the fore part of the tibia, it runs along the outer edge of the ligamentum patellæ to gain the bone, where it anastomoses with the last-described ramus. In this course, it also supplies ramuli to the muscles, and anastomoses with the superior, external, and middle articular rami.

The inferior muscular branches supply the gastrocnemii and solei, and anastomose with the posterior and anterior tibial rami—these are sometimes called the surales.

The popliteal artery, after having given off the preceding vessels, continues downwards, behind and to the lower edge of the popliteus muscle, where it divides into the posterior and anterior tibial rami.

(F.) *Ramus tibialis posticus*—is the larger of the two terminating branches of the popliteal artery, from which it separates at the superior extremity of the soleus muscle; anterior to which, it passes downwards upon the posterior surface of the flexor longus digitorum, and tibialis posticus muscles, to the malleolus internus ; passing behind which, it gains the sole of the foot ; and immediately upon the inner side of the abductor pollicis, it divides into its two terminating plantar ramuli.

In its course downwards upon the leg, it passes in an oblique direction, from above to below and from without to within;—in the upper and middle third of the leg, being covered by the gastrocnemius, and soleus muscles ; but in the lower third, it is only covered by the skin, superficial and deep fascia. When first given off from the popliteal artery, it lies upon the tibialis posticus, then upon the flexor longus digitorum ; and below, upon the tibia, and internal lateral ligament of the ankle-joint ; separated, however, from the superficial layer of muscles, by the deep fascia of the leg. In the above course, it sends off only one ramulus of import-ance ; but it supplies small ramuli to the popliteus, soleus, and gastrocnemii muscles ; and an inch below the popliteus muscle, gives off—

(a.) *Ramulus peronæus*—which is variable in its size,

sometimes being equal to the posterior tibial in its dimensions, at others being very small, or even entirely wanting. It directs itself obliquely downwards and outwards, along the inner edge of the fibula, nearly to the malleolus externus, where it forms two terminating ramusculi; above, it is covered by the soleus, separated from it, however, by the deep fascia of the leg; below, by the flexor longus pollicis: at first it rests upon the tibialis posticus, through the fibres of which it passes, and then lies on the interosseous ligament. In this course, it furnishes small posterior ramusculi to the muscles of the calf of the leg, and anterior ones to the deep layer of muscles; after which it divides into—

(a.) *Ramusculus peronæus posterior.*—This appears to be a continuation of the peroneal ramulus, and passes downwards behind the malleolus externus, distributing ramifications to the muscles in its course: when it has gained the posterior part of the ankle-joint, it sends a posterior malleolar ramification to anastomose with the posterior tibial ramulus, and to supply the adeps and cellular membrane between the tendo Achillis and posterior part of the ankle-joint.

The ramusculus peronæus posterior, still continues behind the malleolus externus, and reaches the outer side of the foot, where it anastomoses with the external plantar ramulus; and in front of the tarsus, with ramuli from the tibialis anticus.

(β.) *Ramusculus peronæus anterior*—perforates the interosseous ligament, to gain the fore part of the leg, passes under the peronæus tertius muscle, descends in front of the inferior tibio-fibular articulation, and passes to anastomose with the ramus tibialis anticus; and together, supply the anterior malleolar ramification, and the ligaments of the tarsus. This ramusculus is, in some cases, very large, and seems destined to perform the office of the anterior tibial ramus, which, in such instances, is proportionably small.

After the ramus tibialis posticus has given off the ramulus peronæus, in its passage down the back part of the leg, it

gives off ramuli to the muscles, and a nutritious one to the tibia, which passes into the bone through a foramen which is directed from above downwards, and is situated about the centre of the bone. When the posterior tibial ramus has reached the inner side of the malleolus internus, it sends off small ramuli to supply the periosteum of the bone, and muscles proper to the great toe; and usually between the origins of the abductor pollicis pedis, it divides into its two terminating plantar ramuli.

·(b.) *Ramulus plantaris internus*—is smaller than the external terminating ramulus, and passes forwards along the inner edge of the foot, upon the upper surface of the abductor pollicis muscle, and extends as far as the base of the first phalanx of the great toe. In this course, it sends off ramusculi to supply the ankle-joint, the muscles of the great toe, and the flexor brevis digitorum; also ramusculi which wind around the inner side of the foot upon the tarsus and metatarsus, to anastomose with the ramus tibialis anticus, and terminate by supplying the great toe.

(c.) *Ramulus plantaris externus*—seems like a continuation of the posterior tibial ramus. It immediately separates itself from the internal ramulus, and directs itself outwards and forwards; first resting upon the upper surface of the abductor pollicis, then upon the flexor brevis digitorum communis, being between it and the musculus accessorius; it still continues outwards to the metatarsal bone of the fifth toe, from the base of which it runs between the flexor digitorum brevis, and abductor minimi digiti, where it is straight in its course, and superficially placed; it then changes its direction, passes inwards inferior to the tendons of the flexor longus digitorum and lumbricales, and is placed upon the under surface of the interossei muscles: having arrived in the interspace between the anterior extremities of the metatarsal bones of the first and second toes, it terminates by anastomosing with the deep communicating ramulus of the ramus tibialis anticus. In this course, the external plantar ramus forms the great plantar arch, the

convexity of which looks forwards and outwards, and the concavity backwards and inwards. The ramulus plantaris externus, before it begins to form the plantar arch, sends off numerous ramusculi to supply the muscles of the sole of the foot, and to anastomose with the ramusculus peronæus posterior, and internal plantar ramulus. From the arch itself, ramusculi are also distributed: from the concavity the—

(α.) *Ramusculi perforantes*—which pass to the interossii muscles, and anastomose on the dorsum of the foot, with the anterior tibial ramus; and from the convexity the—

(β.) *Ramusculi digitales.*—The first of these arises from opposite the metatarsal bone of the little toe, passes forwards between it and the muscles proper to the toe, proceeds forwards to the extreme phalanx along its outer side, and then anastomoses at the tip of the toe, with the corresponding ramusculus from the opposite side.

The second digital ramusculus, takes a course between the metatarsal bones of the fourth and fifth toes; and having passed forwards to the cleft between the two, it receives a metatarsal ramusculus from the anterior tibial ramus, and immediately after it divides into two ramifications—one of which passes along the tibial side of the little toe, and the other along the fibular side of the fourth toe.

The third and fourth digital ramifications are distributed precisely in a similar manner; and like the digital ramifications on the fingers, are accompanied with corresponding filaments of nerves.

(G.) *Ramus tibialis anticus*—immediately after it is separated from the popliteal artery, is directed forwards, through the fibres of the tibialis posticus muscles and the upper hiatus of the interosseous ligament, when it is placed in the fore part of the leg, upon the anterior surface of the interosseous ligament, along which it proceeds downwards; and passing behind the ligamentum annulare, gains the dorsum of the foot, continues to the cleft between the metatarsal bones of the great toe, and the toe next to it, and terminates

by anastomosing with the ramulus plantaris externus. A line drawn from the head of the fibula to the base of the metatarsal bone of the great toe, will be parallel to the course of this ramus in its whole extent.

In this course, before it passes through the interosseous hiatus, it is placed between the fibres of the tibialis posticus and the flexor longus digitorum muscles, to both of which it sends off ramuli. When it has reached the front part of the leg, in the four upper fifths of its extent, it rests upon the interosseous ligament, but in the lower fifth, upon the tibia. Anteriorly, above, it is covered by the tibialis anticus, and extensor communis digitorum; and below, by the extensor proprius pollicis; it is bounded upon its inner side, in its whole course, by the tibialis anticus and tibia; and on its outer side, above, by the extensor digitorum communis, and below, by the extensor proprius pollicis; being accompanied by a nerve, which does not however pass through the interosseous hiatus with it, but winds around the head of the fibula.

While upon the leg, it sends off three ramuli—

(a.) *Ramulus recurrens*—is separated from the ramus tibialis anticus, immediately it has perforated the interosseous hiatus; takes its course upwards and inwards, through the substance of the tibialis anticus muscle, and is distributed to the inner side, and fore part of the knee-joint, where it anastomoses with the inferior articular rami, from the popliteal artery.

The ramus tibialis anticus, in its course downwards to the ankle-joint, distributes numerous ramuli to the neighbouring muscles; but within one or two inches of the ankle-joint, it sends off—

(b.) *Ramulus malleolus internus*—which passes transversely inwards, between the tibialis anticus tendon and the tibia, to reach the malleolus internus, where it divides into numerous ramusculi to supply the ankle-joint, and to anastomose with the ramus tibialis posticus.

(c.) *Ramulus malleolus externus*—usually arises oppo-
site the last-described, but sometimes lower down, and takes
its course outwards upon the fibula, behind the tendons of
the extensor communis digitorum, and peronæus tertius;
in this part of its course anastomosing with the ramusculus
peronæus anterior, and supplying the anterior ligament of
the inferior tibio-fibular articulation. It still continues out-
wards, gains the malleolus externus, divides into numerous
ramifications, which anastomose posteriorly with the ramus-
culus peronæus posterior, and inferiorly are lost upon the
dorsum of the foot—anastomosing with the ramulus plan-
taris externus. The ramus tibialis anticus now proceeds
over the tarsus, on the fibular side of the tendon of the ex-
tensor proprius pollicis; and having gained the dorsum of
the foot, proceeds forwards to its termination.

In front of the ankle-joint, and while crossing the os
naviculare, this ramus gives off—

(d.) *Ramulus tarsalis.*—This takes its course outwards,
under the tendons of the extensor brevis digitorum com-
munis, and the tendon of the peronæus brevis; and ter-
minates by supplying the muscles proper to the little toe,
and by anastomosing with the external plantar ramulus.
The ramus tibialis anticus, having reached the metatarsus,
sends off—

(e.) *Ramulus metatarsalis.*—It takes its course outwards,
over the heads of the metatarsal bones supplying their arti-
culations; anteriorly sending off three or four long ramus-
culi in the three outer interosseous spaces, and which ter-
minate by communicating with the digital ramusculi of the
external plantar ramulus.

When the anterior tibial ramus gains the anterior part of
the interspace between the first and second metatarsal bones,
it terminates by dividing into two ramuli.

(f.) *Ramulus communicans*—which dips down at once
into the sole of the foot, and anastomoses with the termina-
tion of the ramulus plantaris externus.

(g.) *Ramulus pollicis*—follows the interval of the two first metatarsal bones, and divides into two ramusculi to supply the opposite sides of the first and second toes. Before the ramus tibialis anticus divides into its two described terminating branches, it sends some ramusculi of inferior importance along the dorsal surface of the great toe.

# LECTURE XXVII.

### *Practical Remarks.*

HAVING finished the descriptive anatomy of the arteries, our next consideration is the practical utility which a thorough knowledge of these vessels imparts to the accomplished surgeon. No man ought to practice surgery, who has not made the study of the arteries a principal object of his professional knowledge.

In order to impress the great importance of this branch of anatomical science, I have reserved the practical remarks, connected with the arteries, for a separate lecture; that, in a connected view, I may perform and explain the several operations which are employed in tying the various arteries of the body.

Such operations are generally required to stop the hæmorrhages which may occur in accidents or from diseases; and in the latter most frequently, in order to stop the flow of blood to an aneurismal tumour. I will, therefore, very briefly enumerate some of the diseases incident to the arteries; and in so doing, lead your attention to the causes which frequently lead to the formation of aneurisms.

The arteries, in common with most animal structures, are liable to inflammation and its consequences; such as the effusion of lymph, adhesion, suppuration, and gangrene.

The peculiar organization of the arteries, and their particular function circulation, occasions certain modifications of disease, which are only to be met with in the arteries themselves; of which the disease named aneurism is an example.

There is a great tendency in arteries to the adhesive inflammation, whether excited from accident or other causes. It is to this tendency that we owe the process of reparation from wounds or disease; the lymph thrown out becoming the matrix of the new organized structures.

Even upon mere pressure, lymph will be thrown out in the interior of a vessel; and if long continued, as in the case of tumours of slow growth, such depositions will occasion the final obliteration of the vessel. Similar effusions of lymph sometimes take place near to an ulcerated part; and forming plugs, thus become the means of final obliteration.

Effusions are met with in various situations, but particularly in the

large arterial trunks, and in the heart itself, of which there are several very fine specimens in our Museum. These effusions becoming detached, in some instances, appear to occasion the obliteration of an artery, by forming a plug at the first place at which its progress becomes impeded. In the Museum we have specimens of the aorta thus obliterated by a firm, fibrous coagulum, which is continued into the iliacs.

In acute inflammation of the arteries, the internal and middle coats exhibit a high degree of color, with the thickening and effusion of lymph: this must not, however, be mistaken for a florid red appearance that occasionally occurs, in which the internal coat only has a deep scarlet color. Sometimes this appearance will be general; at others, only in patches: it is also unattended either by effusion of lymph, or thickening of its coats. Such appearances have been supposed to characterize peculiar idiopathic febrile action.

The arteries are liable to chronic inflammation: to which state I more particularly wish to draw your attention, as a precursor of aneurismal tumours.

It has been observed, that persons who have taken large quantities of mercury, are particularly liable to chronic inflammation of the arteries; in which the internal coat becomes thick, soft, and of a deep red color. Similar appearances are also seen in the neighbourhood of calcareous deposits: sometimes in patches; at others, more generally diffused. From these and other causes, the vessels undergo a morbid change, in which they are less capable of sustaining the force of the current of circulation, and they give way; sometimes rupturing to such an extent as to cause instant death; at others, an ulcerative process is set up, in which the coats of the vessel will be partially or completely destroyed, so as to admit of the escape of the blood into the surrounding cellular membrane, and thus forming an aneurism.

Ulcerations of the above description are not unfrequently met with, encircling chalky depositions in the coats; and when these are pressed, matter will escape from beneath them. The appearance of puss within the interior of an artery, in *post mortem* examinations, is, however, rare, from its having been removed by the current of the circulation.

Sphacelus in arteries seldom or ever occurs, unless in connection with the mortification of the parts which surround them. In such instances, fatal hæmorrhage is prevented by the following process, which may be regarded as one of the most wonderful provisions of nature:—The blood coagulates to a considerable extent above the line of sphacelation, at first forming only an effectual plug; this afterwards becomes absorbed, and the vessel completely closed.

Besides the above diseases, the coats of the arteries are separately liable to various peculiar morbid changes.

The internal lining or membranous coat sometimes becomes thickened, and converted into a substance resembling cartilage. There is in the Museum fine specimens of this disease, accompanied with calcareous and atheromatous depositions, in the lower part of the aorta and the iliacs. Such alterations of structure will often be found to be surrounded with chronic inflammation; the redness of which, however, does not extend to the cartilaginous structure. This state is a frequent occurrence about the valves, and in diseases of the heart itself; occasioning that increased action of the left ventricle, which has been named active aneurism of the heart.

The internal coat of the arteries is also liable to become thickened, exhibiting a pulpy structure, somewhat resembling minute granulations; occasionally regularly disposed; at other, irregularly, and assuming a fleshy appearance. This leads to a weakened state of the internal coat, from which it will readily be lacerated, and thus lay the foundation of aneurism.

A frequent disease is met with in the cellular membrane, which connects the internal with the middle coat. In this, an atheromatous or purulent matter, of an opaque yellow color, fills the cells between the coats, and causes a slight elevation. When punctured, purulent or cheesey matter may be pressed out; and when very abundant, occasionally leads to the obliteration of an artery.

One of the most frequent alterations of structure is the deposition of calcareous matter, perhaps erroneously termed ossification of the arteries. In old persons, this is very commonly met with: sometimes enclosing nearly the whole circle of the artery; at others, in very irregular patches; of which we have several fine specimens in the Museum. These depositions are less frequent in the upper than in the lower extremities : they are frequent in the aorta, and rare in the pulmonary artery. Sometimes these depositions are surrounded by ulcerations; which, penetrating the internal coat, will give rise to the formation of aneurism; or, by weakening the parietes, it may occasion a rupture of an artery, when spurious aneurism will immediately follow.

It will be obvious, that a due consideration of the various pre-existing symptoms should be carefully attended to, as they form a guide to the proper mode of constitutional treatment.

In examining the relative position of the aorta with the neighbouring important organs, it must appear obvious at once how various must be the symptoms produced by any enlargement of this large arterial trunk, from its consequent pressure upon them. Thus an aneurism may produce dyspnœa, by pressing on the trachea, or by preventing the

free access of blood to the lungs through the pulmonary artery : diffi-
culty of swallowing may occur, from its pressure on the œsophagus ;—
a livid countenance and œdematous upper extremities may be promi-
nent symptoms, from the pressure preventing a free return of blood
through the venæ innominatæ. Sudden and immediate death is usually
the sequel of these symptoms, from the aneurism bursting either into
the trachea, œsophagus, or chest—as indicated by coughing up or vo-
miting large quantities of blood. In the museum at Guy's Hospital
we have several preparations exhibiting the diseased states of the vessels
which had occasioned such fatal terminations.

The aorta is sometimes obliterated during life, by the deposition of
bone, or the formation of firm coagula, of which there are three speci-
mens in the museum of Guy's Hospital. There is also a preparation,
particularly worthy attention, in which there are minute openings in an
aneurismal sac of the lower part of the arch of the aorta, produced by
two spiculæ of bony matter in a bronchial gland—the rest of the artery
was sound. The patient died suddenly, from the escape of blood into
the posterior mediastinum.

If, then, the student dwells upon the consideration of the effects
produced by these circumstances, he will see the necessity for mature
thought before he proceeds to the mechanical means of alleviating some
of the symptoms. I may exemplify what I mean, by relating a case,
in which Mr. Key was called upon to perform the operation of bron-
chotomy, for a supposed disease of the larynx; but, by a judicious
investigation into the history of the case, he discovered that the symp-
toms arose from an aneurism of the aorta pressing on the trachea: and
thus he saved the patient from a distressing operation. There is a pre-
paration in the museum at Guy's Hospital, in which the larynx was
opened for difficulty of breathing, caused by an aneurism pressing on
the trachea below. In difficulty of swallowing, also, stricture of the
œsophagus is not always to be supposed the only cause, as it may arise
from the pressure of an aneurismal tumour.

Having considered the diseases of the arteries, which lead to the
formation of aneurismal tumour, as well as the complicated symptoms
induced by them, we will now proceed to consider the surgical opera-
tions necessary for their cure; which consists of the application of a
ligature around the diseased vessel, so as to preclude the possibility of
the flow of blood to the tumour; which effect is permanently produced,
not by the mere approximation of the sides of the vessel, and their
adhesion, but by its rupturing the internal coat, and thus inducing an
effusion of adhesive matter, which obliterates the vessel. It however
sometimes occurs, that the aneurismal tumour is situated so near to the
heart, that it does not admit of the application of a ligature around the

vessel, between the heart and the tumour: in such instances, it will sometimes be proper to place a ligature on the distal side of the tumour, in order to induce an inflammation, which may extend into the cavity of the aneurismal sac, and thus effect its permanent obliteration.

There are several cases on record, where this mode of operating has succeeded.

Previous to a particular description of the several modes of tying the different arteries, it will be necessary to inform the student, that he is not to expect invariably to find the arteries as we have here described them; but that, in each operation, difficulties may arise from peculiarities of distribution. These deviations from the general mode of distribution, have already been mentioned in the descriptive anatomy; but we shall again refer to them, in the history of each operation, as their importance cannot be too much impressed upon the memory.

In the Museum we have several excellent preparations of the varieties of distribution, which so frequently occur in the large arteries arising from the arch of the aorta; and one in which the aorta arises from both ventricles of the heart. In this specimen, there is a communication in the upper part of the septum of the ventricles; and the pulmonary artery communicates with the aorta by the ductus arteriosus, but does not open into the right ventricle.

The two common carotids, not unfrequently have been found to arise by one common trunk; after which, they are divided to be distributed in the usual manner; in such instances, the right subclavian, arises from the anterior part of the arch.

Four arteries sometimes arise from the arch of the aorta—the additional one being usually placed between the left carotid and left subclavian; from whence it passes in the usual course of the left vertebral ramus, through the transverse processes of the cervical vertebræ. In other instances, the fourth vessel will be distributed to the thyroid gland; but when this happens, it is usually given off from the aorta, immediately to the left of the arteria innominata.

The right subclavian artery, is not very unfrequently given off from the left of the arch, either in common with the left subclavian, or separately; and then passing across the spine, either behind the œsophagus and trachea, or between them, to gain the right side of the neck. Of each of these varieties we have specimens in the Museum; and, indeed, such deviations are not so rare as might be supposed; for there is scarcely a season but some of them are to be met with in the dissecting room.

The large arteries arising from the arch of the aorta, are occasionally the subjects of aneurism, at such a distance from the heart as will admit of the application of a ligature.

The operation for placing a ligature around the arteria innominata, was first performed in 1818, by Dr. Mott, at New York; which operation we will now proceed to describe.

The patient being placed on his back upon a table of convenient height, an incision is to be made, three inches in length, in a direction upwards and backwards, commencing from the centre of the upper piece of the sternum, and then continued along the inner edge of the sterno-cleido mastoideus, so as to expose that muscle. The attachment of the sterno-cleido mastoideus to the sternum, should then be cautiously cut through; and the patient's head being raised from the pillow by an assistant, the operator should now separate the sterno-hyoideus and sterno-thyroideus muscles from the trachea with his fore finger, along which a probe-pointed bistoury is to be guided to divide them from their attachments to the sternum and posterior ligament of the sterno-clavicular articulation. In this step of the operation, some small vessels will be divided, and produce a hæmorrhage; but scarcely ever sufficient to render it necessary to secure them. The fore finger of the left hand may now be passed forwards into the chest, and just behind the middle part of the first bone of the sternum, the arteria innominata will be felt, lying upon the fore part and right side of the trachea; from which it may readily be separated, and a ligature be passed around it about half an inch below its bifurcation.

It has been recommended by some surgeons, that the operation for tying the arteria innominata, should be performed by making an incision from the centre of the upper piece of the sternum, upwards to the cricoid cartilage, in the mesian line of the trachea; then separating the sterno-hyoidei and sterno-thyroidei of one side from those of the other, the finger is to be passed down into the chest to secure the artery, as in the operation above described. But should more room be required, the sterno-cleido mastoideus, hyoideus, and thyroideus of the left side, should be divided in preference to those of the right; in consequence of the anterior position of the arteria innominata rendering the dissection on the right side more dangerous. In the dead subject, I have found this an easier mode of reaching the arteria innominata, than in that which I have first described.

The case in which Dr. Mott tied this vessel, did not succeed, as the patient died from hæmorrhage twenty-six days afterwards; from his having been improperly allowed to walk about too soon after the operation.

The *common carotid arteries*—may be secured, either above, or below the omo hyoideus muscle; and referring to the descriptive anatomy of this vessel, it will be obvious that the upper operation is by far the easier of the two.

Circumstances, however, may arise, from peculiarities in the situation of aneurismal tumours, or from the direction of lacerated wounds, which may preclude the surgeon from making a choice of the easier operation.

In performing the upper operation, as it is termed, the patient should be placed upon a long table, in a completely recumbent posture, the head being extended so as to stretch the neck. An incision is to be made, commencing just below the angle of the lower jaw, and extending three inches in a direction towards the side of the cricoid cartilage; dividing the common integuments, and the platysma myoides only. The fascia of the neck is next to be divided, cautiously, to the same extent—taking care to avoid numerous small veins, which are placed immediately beneath it; for which purpose a director is to be employed. The edges of the wound being separated, the carotid sheath will be exposed; and the operator should now look for the descending branch of the lingual nerve, which is usually placed rather to the outer side of the carotid sheath. This sheath should then be raised with a pair of forceps; and to be opened with care, the operator must hold the knife horizontally, and make gentle strokes upon the inner or laryngeal side, until the opening is of sufficient extent. This effected, the internal jugular vein will sometimes be seen, distending itself, so as to cover the artery at intervals. This vein must therefore be drawn with a blunt retractor towards the mastoid muscle; when the par vagum will be seen, between the artery and vein.

The aneurismal needle armed with a ligature is now to be introduced, from without to within, between the par vagum and the artery; at the same time taking care not to include the sympathetic nerve, or its superficial cardiac branch, which is placed on the tracheal side of the artery, but both of them outside the sheath.

The ligature is then to be tied, and one end of it cut off close to the vessel, while the other is to be secured on the side of the neck with a piece of adhesive plaster. This method is necessary, to prevent the possibility of its being entangled with any thing, or being drawn from the artery by any movement of the patient's head. The wound should now be dressed, and the patient placed in bed, with the head so raised as to relax the muscles of the neck.

For the performance of the lower operation, the patient should be placed in the recumbent posture, as before described; but the head should be rather more raised, so as to relax the sterno-cleido mastoideus, and the muscles which cover the carotid artery at the inferior part of the neck. The first incision should divide the common integuments, the platysma myoides, and superficial fascia; and should commence opposite to the cricoid cartilage, and extend downwards and

obliquely inwards, along the tracheal edge of the sterno-cleido mas-
toideus, to within half an inch of the sternum. This incision exposes
the inner edge of the sterno-cleido mastoideus, which forms the outer,
and the sterno thyroideus, the inner boundary of the wound. These
two muscles must then be separated from each other with retractors,
including with the sterno mastoid muscle, a large vein usually found
running along its edge. By this step the sheath of the carotid artery
will be exposed, and the descending branch of the lingual nerve passing
on its inner side. This nerve must then be drawn aside with the sterno
thyroideus muscle. The omo hyoideus will be seen crossing the carotid
sheath at the upper part of the wound; immediately below which
muscle, the sheath should be opened, in the same cautious manner as
described in the high operation; indeed, even more care is necessary,
as the jugular vein is not only larger, but is influenced by the action of
the heart; especially upon the left side, where the operation is one of
greater difficulty than on the right, in consequence of the proximity of
the œsophagus and the thoracic duct.

The operation for tying the *external carotid artery*, is similar to
the upper operation for securing the common carotid; but should not
be resorted to, excepting in such cases, where from accidents, or the
removal of tumours in its neighbourhood, it may be immediately
necessary to secure this vessel. In diseases, it is preferable to secure
the common carotid, in consequence of the numerous ramuli of the
external carotid being so likely to prevent its obliteration after the
separation of the ligature.

Although it is not from this reason advisable to put a ligature
around the external carotid artery itself, its branches may, either from
disease or accident, require that operation.

*Ramulus thyroideus superior*—the first branch sent off from the ex-
ternal carotid, has frequently to be tied, from being divided in attempts
at suicide; and I have myself twice seen a ligature placed around this
vessel, in an attempt to cure bronchocele. When divided by an incised
wound, the bleeding vessel is readily secured by taking it up with a
tenaculum; or perhaps it is safer to take up both extremities, to secure
them more effectually from the continuation of hæmorrhage, which is
liable to occur, from the frequent anastomosis with its fellow, and with
the inferior thyroideal ramulus. When a ligature is to be applied
around this ramulus for a disease, the operation should be performed in
the following way.

The patient should be placed on a table, in the same position as for
tying the carotids, although the sitting position is frequently recom-
mended; it is, however, a plan I deprecate, in all important operations;
for when in the recumbent position, you deprive the patient of every

fixed point for muscular action, and he remains passive, and more perfectly under your control. An incision should be made from the cornu of the os hyoides, obliquely downwards and outwards, to the sterno-cleido mastoideus, dividing the common integuments, platysma myoides, and fascia; then with the handle of the knife clearing away the cellular membrane, and a plexus of veins immediately below the os hyoides, the superior thyroideal ramulus may be exposed. Care must be taken not to include the laryngeal nerve within the ligature when passed around the vessel, as this nerve accompanies the artery, but is rather deeper than it.

The *ramulus maxillaris, vel facialis externus*—and its numerous ramifications, offer various important pathological considerations in operations for the removal of glandular tumours from under the jaw, when it, or its submental branch is necessarily wounded; and from the depth of the parts, is secured with considerable difficulty.

The extirpation of the submaxillary gland, could not be performed without the division of the facial artery; but this operation, is on other accounts rendered exceedingly difficult, from the depth to which this gland penetrates to gain the upper surface of the mylo hyoideus muscle, and become connected with the sublingual gland. These impediments render a perfect extirpation nearly impracticable.

In the removal of portions of the lower jaw, this artery must also be divided; but the difficulties accruing from its division may here be obviated, by taking care to divide it near to the alveolar process of the jaw, and not close to its inferior edge, under which it would retract so deeply as to render it extremely difficult to be secured. By placing the finger within the mouth, and pushing the parts forward from below the jaw, the divided extremity of the facial artery may be readily brought to view; and by this means, temporary pressure may be effected, both from within and without, in order to arrest any sudden or violent hæmorrhage. In operations on the lips for the removal of cancers, or the closing of hare lips, compression of the facial artery on the horizontal portion of the jaw, avails but little, in consequence of the free anastomosis of the coronary vessels, which must be themselves compressed.

After portions of the lips are removed, no ligature is required, as the suture which brings the parts together, may be so passed through the substance of the lip as to check all bleeding.

In the operation for fistula lachrymalis, attention should be paid to make the incision into the sac on its external side, in order to avoid wounding the arterial angular ramusculus.

The *ramulus lingualis*—in wounds and diseases of the tongue, may sometimes require to have a ligature placed around it; to effect this, an

incision must be made from the upper edge of the cornu of the os hyoides, with a slight obliquity upwards and outwards, to the anterior edge of the sterno-cleido mastoideus; this incision should divide the skin and platysma myoides, so as to expose the cervical fascia, which should next be divided, to the same extent and in the same direction; thus laying bare the tendon of the digastric muscle, immediately below which is placed the lingual nerve, and still deeper the lingual artery, where it may be seen immediately above the cornu of the os hyoides, just as it is passing upon the upper surface of the stylo glossus muscle—some few fibres of which may require to be cut through, to enable the operator to place a ligature around it. In the living subject, this will be found to be a much more difficult operation than would be supposed, from the comparative facility of exposing the lingual artery in the dead subject.

Surgeons are sometimes required to divide the frenum linguæ, in cases called tongue-tied, shewing the child has not the free motions of the tongue. In this operation, a probe-pointed scissors should be used, and their blades directed downwards, and not towards the under surface of the tongue, in order to avoid wounding the ramusculus raninus.

The *occipital and posterior aural ramuli*—have, in some few instances, been tied, in cases of aneurism by anastomosis. The plan which may be adopted in securing these vessels, is to feel for their pulsation, and then to cut down immediately upon them.

The *ramulus temporalis*—is not unfrequently the subject of arteriotomy, in diseases of the eye or brain; and the following plan may be adopted for its safe performance.

The anterior ramusculus should be chosen; for if the ramulus be opened near the zygoma, and before its division, it is so covered by fascia, that it will be found difficult, afterwards to suppress the hæmorrhage. Having felt the anterior ramusculus with the fore finger of the left hand, the skin over it, is to be drawn downwards towards the face; then making an incision of an inch long, parallel to the ramusculus and below it, the tension of the finger being removed, the skin recovers its position, and brings the opening opposite the vessel,—which is immediately seen lying upon the aponeurosis of the temporal muscle. A probe is to be passed under the ramusculus, which may then be opened with a lancet; and when the quantity of blood required has been taken, the vessel is to be divided, and pressure applied to stop the hæmorrhage. The passing the probe under the vessel is not only useful to give a perfect command of it, but it prevents the wounding of the temporal aponeurosis.

Even with this precaution, spurious aneurism is sometimes the result of this operation; to cure which, the sac should be laid open, the

coagulum turned out, and a ligature applied on each of the openings in the vessel.

The *subclavian artery*—is more frequently the subject of operation for the diseases which are incident to its axillary portion, than for diseases situated in its own course; this may, in some measure, be accounted for, from the axillary artery being exposed so much more to changes of position during the motions of the upper extremity.

To secure the *subclavian artery*, on the outer side of the scalenus anticus muscle, which is the situation invariably chosen for this operation, on account of the insuperable difficulties which are incident to its other portions, the patient should be placed in the recumbent posture upon a low table, with his shoulders slightly raised by a pillow being placed beneath them. The arm of the diseased side, is to be drawn downwards and held by an assistant close to the patient's body, the shoulder at the same time being pressed backwards. This places the subclavian artery in the best possible situation to be secured. The operator then draws the skin of the neck downwards upon the chest, rendering it tense over the clavicle. Supposing the clavicle is divided into four equal portions, an incision is to be made in the course of that bone to the extent of the two middle fourths—dividing the skin, superficial fascia, and platysma myoides. The inner boundary of the opening made by this incision, is formed by the outer edge of the sterno-cleido mastoideus muscle; the outer boundary, by the inner edge of the trapezius; above, by the receding skin; and below, by the clavicle. It occasionally happens, that the external jugular vein passes in such a direction as, without due caution, to endanger its being wounded by this incision; but it is usually underneath the sterno-cleido mastoideus muscle. The operator should now separate the deep fascia of the neck, and the cellular membrane, with the handle of his scalpel or a silver knife, until he reaches the acromial side of the scalenus anticus muscle; in doing which he is to avoid the large veins, which are passing to terminate in the subclavian. The particular object in this step of the operation, is to expose the outer edge of the scalenus anticus muscle, as it alone points out the precise situation of the subclavian artery, in its passage over the first rib. In effecting this object, some difficulty occasionally occurs, from the enlargement of the absorbent glands, which will render more dissection necessary. The third step consists in the operator passing his finger along the outer edge of the scalenus anticus muscle, until he reaches the first rib; upon which he will feel the subclavian artery pulsating under his finger; and with his nail as a director, he is then to separate the artery from its attachments to the first rib, so as to enable him to pass the aneurismal needle, armed with a ligature, under it—in a direction from within and below, upwards

and backwards; taking care to avoid the axillary plexus of nerves, which are above and to the outer side of the artery. Before the ligature is tightened, the surgeon should ascertain by its pressure upon the artery, that with it, he commands the pulsation of the aneurismal tumour; for I have seen the ramulus supra scapularis so enlarged, as to be mistaken for the subclavian artery. The ligature being secured, one end is to be cut off close to the vessel; the other left, and the wound closed with adhesive plaster in the usual manner.

When the clavicle is much raised, either by the peculiar make of the individual, or from the pressure of the aneurismal tumour, the difficulty of the operation is much increased, and may lead to the necessity of dividing the omo hyoideus muscle, in order to obtain more space: but under all circumstances, the scalenus anticus muscle is the guide to the vessel. It is necessary to be very careful not to wound the external jugular vein, in the first step of the operation. The importance of this caution, I may instance by a case at Petersburg, related to me by Mr. Brodie, in which instantaneous death occurred from the division of this vein. Upon examination after death, the right auricle of the heart was found full of air; which can only be accounted for by the empty state of the vein at the moment of the division. Should any circumstance render the division of the vein necessary, two ligatures should be first applied.

The remaining portion of the arteries of the upper extremity, may be secured in any part of their course, excepting the middle third of the axillary artery, where it is surrounded by the axillary plexus of nerves, so as to preclude the possibility of applying a ligature in that situation.

It would be needless here to enter into a minute detail of the steps which may be required, in the several operations of tying those arteries; as the descriptive anatomy, it is presumed, must form an efficient guide. I shall therefore only mention, that in consequence of the frequent irregularities in the distribution of these vessels, any particular rules would lead to embarrassment upon the occurrence of such deviations; and that, therefore, it is of the utmost importance that the surgeon, before he proceeds to secure any of these vessels, should by the most careful examination, endeavour to ascertain whether such irregularities exist or not; by which he must accordingly regulate the steps of his operation.

There is, perhaps, no accident connected with the arterial system, more perplexing, than wounds in the palm of the hand; it seems to be, invariably, a bad practice to attempt to secure the vessel where divided; as in every fibre which you divide to expose the bleeding vessel, fresh injuries are accumulated, and the blood seems to issue from an extended surface, rather than from an individual trunk. The best mode of

treatment is, therefore, first to press upon the radial or ulnar, or both vessels, as may be found necessary, to check the hæmorrhage; the patient should be kept in the recumbent position, and the hand enveloped in wet clothes: such a mode of treatment is to be continued as long as the surgeon may consider it necessary for the healing of the wounded vessel, when the pressure may be removed. But should the hæmorrhage return, the radial or ulnar, or both arteries, must be secured, at the lower third of the fore arm, to prevent fatal consequences.

The intermediate arteries between the upper and lower extremities, admit but of few surgical remarks, as far as refers to operations; but their relative position with important organs should be carefully studied, to enable us to form a just diagnosis from symptoms which are produced by the pressure of aneurismal tumours upon them.

I have already alluded to the various symptoms induced by the pressure of aneurismal tumours of the arch of the aorta, and its large arteries.

Aneurism of the descending aorta, may produce a large tumour in the back, which might possibly be mistaken for abscess; the ribs being absorbed from its pressure. It may also produce great difficulty of breathing, from pressure on the lungs; wasting of the body, from pressure on the thoracic duct; venous congestion, from retarding the flow of blood in the vena azygos; and, subsequently, difficulty of swallowing, by pressing on the œsophagus. Still, urgent as these symptoms are, it requires a scientific surgeon to discover their cause; but the truth may generally be elicited, by a close examination of the action of the heart, and arterial system; when it will be found, that all these symptoms are aggravated by any cause which hurries the circulation; and the patient expresses himself, as feeling as though there were something alive within him—followed by frequent tendency to fainting.

The abdominal aorta, when the subject of aneurism, not being so covered by bony parietes as its thoracic portion, offers a more ready opportunity for examination; but still, covered as it is by the organs of digestion, and the chylopoetic viscera, it produces such a variety of symptoms as to render the diagnosis difficult.

Pulsating tumours in the abdomen, must not be too hastily pronounced aneurismal; for enlarged mesenteric glands, or any tumour lying over the aorta, may receive so strong a pulsatory motion from it, as to lead to an erroneous opinion.

The mode of examining such a patient, is to place him on his back, and then pressing the tumour towards the aorta, the pulsation will be strongly felt, in proportion to the force employed, if it be aneurism; but, on the contrary, if a solid tumour, the same degree of pressure will stop the pulsation of the aorta itself. The patient may also be desired

to turn upon his hands and knees; in which position, a solid tumour would gravitate from the aorta, and lose its pulsation; while, if it be aneurism, this change will make no alteration in the pulsatory motion. By close attention to these rules, I have had frequent opportunities of estimating their value, in forming a just diagnosis.

Persons who are the subjects of aneurism of the abdominal aorta, almost invariably complain of a sensation of fainting upon bending the thighs upon the trunk; as, for instance, in the attempt to mount a high horse, when the thigh is flexed to its greatest extent to place the foot in the stirrup.

In such diseases, the life of the patient may be prolonged by perfect rest; great attention to diet, which should never be of a stimulating quality; by due regulation of the action of the bowels; and by frequent abstraction of small quantities of blood. Indeed, even in this most formidable of diseases, there is yet a gleam of hope; for we have in our museum at Guy's Hospital two preparations, besides others which are extant, in which the aorta had become obliterated, and the circulation still preserved by collateral vessels to the lower extremities.

The existence of such preparations induced Sir Astley Cooper, who was the first surgeon that made the experiment, to resort to the application of a ligature around the abdominal aorta, about three quarters of an inch above its division, in a case of aneurism of the external iliac artery.

Sir Astley Cooper first attempted to apply a ligature upon the common iliac, but from the size of the tumour he found it impracticable; and therefore proceeded to the aorta itself. This he effected in the following manner:—An incision was made in the course of the linea alba, three inches long, in the centre of which was the umbilicus, which was avoided by a curve to the left. The cavity of the abdomen being opened, the convolution of the intestines were turned aside, so that the aorta might be felt pulsating through the mesentery, which was next lacerated by the finger nail, and a ligature readily applied around the aorta; care being taken not to include any of the filaments of the aortic plexus of nerves.—The patient survived the operation forty hours: and on a *post mortem* examination, there was no reason to suppose the patient had fallen a victim to the operation itself, but to the previous hæmorrhages, and constitutional irritation induced by the disease.

Mr. James, of Exeter, had the courage to follow the example of Sir Astley Cooper, in a case of equal urgency; and performed the operation in a similar manner; his patient, however, died in a few hours afterwards, complaining, from the moment the ligature was applied, of great pain in the diseased limb.

Although both of these cases proved unsuccessful, it does not follow that the operation is to be abandoned; nor, on the other hand, because preparations may be seen, in which the aorta has been obliterated by disease, and that the circulation has yet been carried on collaterally, is it to be considered that the application of a ligature is necessarily to lead to the same happy result: for it is to be remembered, that when disease obliterates the aorta, it is rendered impervious by degrees, and that the collateral branches simultaneously and proportionably enlarge; while, on the contrary, by the application of the ligature, the effects are immediate, without a reciprocal accommodation to so great a change.

We shall now proceed to the consideration of the application of ligatures upon the arteries of the lower extremities.

The common iliac, and the two branches into which it divides, and indeed even the aorta itself, I believe may all be tied, with most facility to the operator and safety to the patient, by the following operation; the only difference being in the extent of the wound. The patient being placed in an horizontal position, an incision, commencing half an inch on the pubic side of the centre of Poupart's ligament, and a little above it, is to pass upwards in the direction of an imaginary point, midway between the umbilicus and ensiform cartilage, for three inches in extent. This incision is usually recommended to be made from Poupart's ligament in a direction to the umbilicus; but it will be found, that the above mode is more in the course of the iliac arteries, and there is less liability to wound the epigastric. This first incision divides the skin and superficial fascia of the abdomen, and exposes the aponeurosis of the external oblique muscle, which is next to be cut through in the same direction; and the finger is to be introduced underneath the free edges of the internal oblique and transversalis muscles, which are now cautiously to be divided with a probe-pointed bistoury, in the direction of the external wound. This step exposes the fascia transversalis, and the spermatic cord lying upon it; the operator is to trace the spermatic cord to the internal ring, tear through the fascia spermatica interna, draw the cord upwards and inwards, and pass his finger into the abdomen, through the internal ring, and insinuate it under the peritoneum, when he will immediately feel the external iliac artery; he is then to separate it from its accompanying vein, which lies on its inner side, and to pass the point of the aneurismal needle between the two vessels, directing it outwards to enclose the artery; the ligature is to be tied as soon as it is ascertained that it will command the pulsation of the artery, and the edges of the wound closed by strips of adhesive plaster.

If the object be to secure the internal iliac artery, the incision is to be continued an inch higher than in the last-described operation. The

peritoneum is to be detached by the finger, in a direction outwards from the iliac fossa, inwards towards the pelvis, when the external iliac artery is to be traced backwards to the sacro-iliac symphysis; where in the centre of an imaginary line drawn from the umbilicus to the anterior and superior spinous processes of the ilium, the origin of the interpal iliac may be felt, posterior, and to the inner side of the external iliac artery. The internal iliac is then to be separated from its accompanying vein, which is behind it; and a ligature is to be conveyed around the vessel, directing the needle from within to without—taking care not to include the ureter, which crosses the internal iliac at this point; and which may always be avoided, by feeling for the ureter's obeying the motions of the peritoneum, which the blood-vessels do not.

The common iliacs, and even the aorta itself, may be secured by this latter operation.

Sir Astley Cooper prefers a different operation for tying the external iliac artery, and recommends a semilunar incision to be made, extending from an inch to the inner side of the abdominal ring, to an inch of the spine of the ilium, the convexity of which looks downwards and outwards; by this incision, the aponeurosis of the external oblique muscle is exposed, and is to be divided in the same direction as the external incision—thus laying open the inguinal canal. The free edges of the internal oblique and transversalis muscles, are to be drawn upwards; and when they arise from more than the outer half of Poupart's ligament, they will require to be separated from it to expose the internal ring. The fascia spermatica interna is next to be torn through, the spermatic cord to be drawn upwards, and the artery may immediately be felt and secured. This operation, which I have four times performed, offers greater facility in securing the vessel, than the mode before described; but it is attended with this disadvantage, that if upon exposing the artery disease should exist, so as to render it necessary to secure it higher up, a further operation is required; and also by this mode, the ligature is liable to be too near to the epigastric and ramus circumflexus ilii.

We possess in our museum at Guy's Hospital, a preparation made from a man in whom the external iliac artery had been tied, twenty years before, by Sir Astley Cooper; it presents a beautiful view of the manner in which the circulation had been carried on by collateral anastomosing branches. The principal enlarged vessel, is the obturator; but the ischiadic, gluteal, and circumflex ilii, contribute to the new current of circulation.

Some surgeons have laid down rules for securing the gluteal, ischiadic, and internal pudic rami; but in diseases of these vessels, it

is better to apply a ligature around the internal artery, than to attempt to tie either of them, as they are so deeply seated, and covered by such a mass of muscles.

The femoral artery is frequently the subject of operation, in consequence of aneurism of the popliteal; which, although so much shorter than the femoral, is yet subject to such extensive changes of position, from the motions of the knee-joint, that it is much more liable to disease. The femoral artery may be tied in any part of its course; but the situation which surgeons most frequently choose for the application of the ligature, is at the junction of the superior with the middle third of the thigh. The patient should be placed in the horizontal posture, and the leg of the diseased side should be flexed, and made to cross below the knee of the healthy one. The surgeon is then to commence his incision two inches below Poupart's ligament, at a point which would terminate a perpendicular line, drawn from midway between the anterior superior spinous process of the ilium, and symphysis pubis. The incision is to be continued obliquely downwards and inwards, for three inches in length, along the inner edge of the sartorius, dividing the skin and fascia lata, so as to expose the sartorius muscle. In this step if the surgeon, as sometimes happens, from the enlarged state of the limb, or from the great accumulation of fat, has made his incision too much on the inner side of the thigh, he will expose the adductor longus, instead of the sartorius muscle; this circumstance he will immediately discover, by observing the direction of the muscular fibres,—which in the adductor longus, pass from within to without, but in the sartorius, from without to within. This may be rectified without a further incision, by rotating the limb outwards, and widely opening the outer edge of the wound. The sartorius muscle is then to be raised with the handle of a scalpel, when the femoral sheath is immediately exposed, and should be opened with great caution. The femoral artery will be found lying above its vein, and generally having a branch of the saphenus nerve running upon it. With a director, or a silver probe, the operator should now separate the artery from its vein and nerve; but not to a greater extent than is necessary to enable him to pass the aneurismal needle, armed with a ligature, around it. Having ascertained that the ligature commands the artery, it is to be secured, and the wound closed in the usual manner.

This is termed the upper operation on the femoral artery, in contradistinction to the lower operation; which is performed at the junction of the middle, with the lower third of the thigh.

In the lower operation, the patient is to be placed in the same position as in the upper, excepting that the knee should be rather more

rotated outwards. An incision is then to be made, commencing about the centre of the thigh, and to be continued perpendicularly downwards, three inches in length, cutting through the skin and fascia lata; in which step, the surgeon must take care not to wound the saphena major vein. By this incision the sartorius muscle is exposed, and must be raised, and drawn inwards, instead of outwards as in the upper operation, to bring into view the tendons of the adductor magnus muscle, and the sheath of the femoral artery, composed of a fascia common to the adductor magnus and vastus internus muscles. This sheath is now to be laid open, when the artery will be immediately exposed, with its vein behind it, but no longer accompanied by the branch of the saphenus nerve. A ligature is now to be passed around the artery, taking care not to apply it too near to the ramus anastomoticus magnus, which would interfere with the usual effects of the application of the ligature.

The popliteal artery may be tied, by following nearly the same steps as described in the last operation ; the only difference being, that the incision is to be continued rather lower down, so as to expose the sheath posterior instead of anterior to the tendon of the adductor magnus, which leads immediately into the upper part of the popliteal space.

In such operations, the surgeon should examine whether or not there be varieties from the usual distribution of these vessels, in order that he may take such other steps as may be consequently required.

From injuries to the arteries in the sole of the foot, as well as in the leg to the posterior tibial, it is sometimes necessary to secure this vessel. In the lower third of the leg, between the tendo Achillis and malleolus internus, the posterior tibial ramus may be exposed by making an incision, two inches and a half in extent, along the inner edge of the tendo Achillis. This is to cut through both the superficial and deep fascia of the leg, when the vessel will be exposed, accompanied by its two veins, and its nerve, which is behind and to its outer side. The vessel is then to be secured. The posterior tibial ramus, may, however, require to be tied in the calf of the leg ; which is a more difficult operation, and is to be performed in the following manner :— The patient is to lie in the horizontal posture, on his side, so as to rest on the outer side of the injured or diseased limb. The surgeon is then to feel for the inner spine of the tibia ; and rather anterior to it, is to make an incision three inches long, through the skin, superficial fascia, and the origin of the soleus muscle; he is then to separate the origin of the soleus from the tibia, in the whole extent of this wound ; by which means he will expose the inner spine of the tibia, and the deep fascia of the leg, which arises from it. This fascia is now to be divided to

the same extent, when the artery may be felt lying upon the deep muscles, about an inch to the outer side of the tibia. It is then to be separated from its venæ comites, and an aneurismal needle passed around it; taking care not to include the posterior tibial nerve, which in this situation may either be just crossing it, or on its fibular side. In this operation, the principal points to be attended to, are first, in making your incision through the origin of the soleus from the tibia; not at the same time to divide the deep fascia of the leg, as this is the line of demarcation between the superficial and deep muscles, and the guide which should be followed to find the artery upon the latter. Secondly, when about to apply the ligature around the artery, the leg should be flexed upon the thigh, to relax the superficial layer of muscles; and the foot extended, to relax the deep-seated.

If the *peroneal ramulus* requires to be tied, much the same steps as in the last operation, are to be followed upon the outer, instead of the inner side of the leg.

The *anterior tibial ramus*—may be secured in any part of its course, which is marked by a line drawn from the anterior edge of the head of the fibula, to the interspace between the metatarsal bones of the great toe and toe next to it.

When it is to be tied in the upper part of the leg, an incision three inches in length, is to be made in the course of the above-named line, through the skin, down to the fascia; when an opaque white line may be seen and felt marking the separation between the tibialis anticus, and extensor longus digitorum muscles. This fascia is next to be cut through, to the extent of the external incision; and when the muscles are separated from each other, the artery will be exposed, resting upon the interosseous ligament, accompanied by its veins on either side of it, and its nerve which is in front of it. The foot should now be flexed upon the leg, and the artery being separated from its veins and nerve, the ligature may be passed around it.

. Should it be necessary to tie this vessel in the remaining portion of its course, in a surgical point of view nothing farther is to be considered; but in an anatomical point of view, it is to be remembered that different muscles form its boundaries; which has been already pointed out, in the descriptive anatomy.

The same treatment is required for wounds of the arteries of the foot, which has been already recommended in speaking of the arteries of the hand.

With respect to the medical treatment of patients, who are about to submit to an operation for the radical cure of aneurism, it in general happens, that no previous time is afforded for much to be done, as to the improvement of their constitutions; as the surgeon is generally

called upon to afford immediate relief, by an operation. But should time be allowed, the patient should be kept in the recumbent posture, the limb warmly clothed, and placed in such a position as will facilitate its circulation through collateral vessels, in order that they may become enlarged so as more readily to accommodate themselves to the change which will be produced by the operation.

Great attention should be paid to the state of the bowels; and with respect to regimen, it should be sufficiently nutritious as not to reduce the strength of the patient, and not too stimulating so as to increase the action of the heart and arteries.

The treatment after an operation for aneurism, is much the same as that which is adopted previously; subjected, however, to variety depending upon local and constitutional circumstances. For instance, in some cases the whole sac will slough, when the surgeon is called upon to judge as to the propriety of amputating the limb: this will depend upon the power of the constitution; which, if the surgeon thinks sufficient, he will support it with tonics; but if he considers his patient unable to bear up against nature's mode of reparation, he must sacrifice the limb, to preserve life.

The patient is not to be considered out of danger, until the ligature has separated, which occurs at different periods, depending upon the size of the artery; in large arteries, this generally happens between the fourteenth and twentieth days, depending in some measure, also, upon the constitution of the patient, and whether or not any other parts happen to have been included within the ligature. Should there be any delay in the separation of the ligature, the surgeon should not by any means attempt to hasten it; as it appears to be a provision in nature, not to throw off the ligature before she has obliterated the artery by adhesive inflammation: for it is to be borne in mind, that secondary haemorrhages most frequently occur upon the separation of the ligature, and particularly when unnecessarily disturbed.

# TABLE OF THE ARTERIES.

HEART. {PULMONARY TRUNK,
{AORTIC TRUNK,

The Aortic Trunk is divided into Four Portions:

ASCENDING, ARCHED, THORACIO, AND ABDOMINAL.

## ASCENDING AORTA.

1. ARTERIA CORONARIA DEXTRA, VEL ANTERIOR.
   A. *Ramus superior.*
   B. *Ramus inferior.*
   C. *Ramus posterior.*
2. ARTERIA CORONARIA SINISTRA, VEL POSTERIOR.
   A. *Ramus superior.*
   B. *Ramus inferior.*

## ARCH OF THE AORTA.

3. ARTERIA INNOMINATA.
   A. *Ramus thyroideus medius.*
4. ARTERIA CAROTIDIS COMMUNIS SINISTRA.
4. ARTERIÆ CAROTIDES COMMUNES.
5. ARTERIA SUBCLAVIA SINISTRA.
   A. *Ramus carotidis externus.*
      *a.* Ramulus thyroideus superior, vel descendens.
         α. Ramusculus hyoideus.
         β. Ramusculus laryngeus.
         γ. Ramusculus thyroideus.
      *b.* Ramulus maxillaris, vel facialis externus.
         α. Ramusculus palati inferior, vel ascendens.
         β. Ramusculus tonsillaris.
         γ. Ramusculi glandulares.
         δ. Ramusculus submentalis.

ε. Ramusculi masseteres.

ζ. Ramusculus labialis inferior.

η. Ramusculus labialis superior, vel coronarius.

ϑ. Ramusculus lateralis nasi.

ι. Ramusculus angularis.

c. Ramulus lingualis.

    α. Ramusculus hyoideus.

    β. Ramusculus dorsalis linguæ.

    γ. Ramusculus sublingualis.

    δ. Ramusculus raninus.

d. Ramulus occipitalis.

e. Ramulus auricularis posterior, vel stylo mastoideus.

    α. Ramusculus stylo mastoideus.

    β. Ramusculus membrana tympani.

f. Ramulus pharyngis ascendens, vel inferior.

    α. Ramusculus meningeus.

g. Ramulus temporalis superficialis.

    α. Ramusculus parotideus.

    β. Ramusculus articularis.

    γ. Ramusculus transversus facialis.

    δ. Ramusculus profundus temporalis.

    ε. Ramusculus temporalis anterior.

    ζ. Ramusculus temporalis posterior.

h. Ramulus maxillaris internus.

    α. Ramusculus meningeus medius, vel spheno-spinalis.

    β. Ramusculus maxillaris inferior, vel dentalis.

    γ. Ramusculi capsulares.

    δ. Ramusculi masseteres.

    ε. Ramusculi buccales.

    ζ. Ramusculi pterygoidei.

    η. Ramusculi temporales profundi posteriores.

    ϑ. Ramusculi profundi temporales anteriores.

    ι. Ramusculus dentalis, vel maxillaris superior.

    κ. Ramusculus infra orbitalis.

    λ. Ramusculus palatinus superior, vel descendens.

    μ. Ramusculus nasalis vel spheno palatinus.

B. *Ramus carotidis internus, vel cerebralis.*
   *a.* Ramulus opthalmicus.
      α. Ramusculus lacrymalis.
      β. Ramusculus centralis retinæ.
      γ. Ramusculus supra-orbitalis.
      δ. Ramusculi ciliares.
      ε. Ramusculi musculares.
      ζ. Ramusculus æthmoidalis posterior et anterior.
      η. Ramusculus palpebralis superior et inferior.
      θ. Ramusculus nasalis.
      ι. Ramusculus frontalis.
   *b.* Ramulus communicans posterior.
   *c.* Ramulus cerebri anterior.
      α. Ramusculi corporis callosi.
   *d.* Ramulus cerebri medius.

5. ARTERIÆ SUBCLAVIÆ.
  A. *Ramus vertebralis.*
   *a.* Ramulus meningeus occipitalis.
   *b.* Ramulus spinalis posterior.
   *c.* Ramulus spinalis anterior.
   *d.* Ramulus cerebelli inferior, vel posterior.
   *e.* Ramulus basilaris.
      α. Ramusculus cerebelli anterior, vel superior.
      β. Ramusculus cerebri posterior.
  B. *Ramus axis thyroideus.*
   *a.* Ramulus thyroideus inferior, vel ascendens.
   *b.* Ramulus cervicalis ascendens.
   *c.* Ramulus transversalis, vel superficialis colli.
      α. Ramusculus cervicalis superficialis.
      β. Ramusculus scapularis posterior.
   *d.* Ramulus supra scapularis.
  C. *Ramus mammillaris internus.*
   *a.* Ramuli intercostales.
   *b.* Ramulus comes nervi phrenici.
   *c.* Ramulus diaphragmaticus, vel phrenicus.
   *d.* Ramulus abdominalis.
  D. *Ramus intercostalis superior.*

        *a.* Ramulus posterior.
        *b.* Ramulus externus.
      E. *Ramus cervicalis profundus, vel posterior.*
        *a.* Ramulus anastomoticus.

5. ARTERIA AXILLARIS.
    A. *Ramus thoracicus acromialis.*
      *a.* Ramulus superior.
      *b.* Ramulus inferior.
    B. *Ramus thoracicus supremus.*
    C. *Ramus thoracicus longus.*
    D. *Ramus thoracicus alaris.*
    E. *Ramus subscapularis.*
      *a.* Ramulus anterior.
      *b.* Ramulus posterior.
    F. *Ramus articularis, vel circumflexus posterior.*
    G. *Ramus articularis, vel circumflexus anterior.*

5. ARTERIA BRACHIALIS.
    A. *Ramus profundus superior.*
    B. *Ramus profundus inferior.*
    C. *Ramus anastomoticus magnus.*
    D. *Ramus nutritius humeri.*
    E. *Ramus radialis.*
      *a.* Ramulus recurrens radialis.
      *b.* Ramulus superficialis volae.
      *c.* Ramulus anterior carpi radialis.
      *d.* Ramulus dorsalis carpi radialis.
      *e.* Ramuli dorsales pollicis.
        *α.* Ramusculus dorsalis indicis.
      *f.* Ramulus magnus, vel princeps pollicis.
      *g.* Ramulus radialis indicis.
      *h.* Ramulus palmaris profundus.
    F. *Ramus ulnaris.*
      *a.* Ramuli recurrentes anteriores.
      *b.* Ramulus interosseus. ·
        *α.* Ramusculi recurrentes interossei anteriores.
        *β.* Ramusculus interosseus anterior.
        *γ.* Ramusculus interosseus posterior.

    *c.* Ramuli carpi ulnares anteriores, et posteriores.
    *d.* Ramulus communicans, vel profundus.
    *e.* Ramulus palmaris superficialis.
       *α.* Ramusculi digitales.

## THORACIC PORTION OF THE AORTA.

6. ARTERIÆ BRONCHIALES.
7. ARTERIÆ ŒSOPHAGEÆ.
8. ARTERIÆ INTERCOSTALES.
  **A.** *Ramus dorsalis.*
  **B.** *Ramus anterior, vel intercostalis proprius.*
    *a.* Ramulus superior.
    *b.* Ramulus inferior.

## ABDOMINAL PORTION OF THE AORTA.

11. ARTERIA VEL AXIS CÆLIACA.
  **A.** *Ramus gastricus, vel coronarius ventriculi.*
    *a.* Ramulus superior.
    *b.* Ramulus inferior.
  **B.** *Ramus hepaticus.*
    *a.* Ramulus pyloricus.
    *b.* Ramulus gastricus inferior dexter.
    *c.* Ramulus hepaticus dexter.
       *α.* Ramusculus cysticus.
    *d.* Ramulus hepaticus sinister.
  **c.** *Ramus splenicus.*
    *a.* Ramuli pancreatici.
    *b.* Ramulus gastricus inferior sinister.
    *c.* Ramuli breves.
12. ARTERIA MESENTERICA SUPERIOR.
  **A.** *Ramus colicus superior dexter.*
    *a.* Ramulus anastomoticus sinister.
    *b.* Ramulus anastomoticus dexter.
  **B.** *Ramus colicus medius dexter.*
    *a* Ramulus anastomoticus superior.
    *h.* Ramulus anastomoticus inferior.
  **c.** *R*'*mus colicus inferior dexter.*

  *a.* **Ramulus anastomoticus superior.**
  *b.* **Ramulus anastomoticus inferior.**
  *c.* Ramulus ileo colicus.
 D. *Rami mesentericæ.*
16. ARTERIA MESENTERICA INFERIOR.
 A. *Ramus colicus superior sinister.*
  *a.* **Ramulus anastomoticus superior.**
  *b.* **Ramulus anastomoticus inferior.**
 B. *Ramus colicus inferior sinister, vel sigmoideus.*
  *a.* **Ramulus anastomoticus superior.**
  *b.* **Ramulus anastomoticus inferior.**
 C. *Ramus hæmorrhoidalis superior, vel internus.*
 9. ARTERIA PHRENICA DEXTER.
 A. *Ramus anterior dexter.*
 B. *Ramus externus dexter.*
10. ARTERIA PHRENICA SINISTRA.
 A. *Ramus anterior sinister.*
 B. *Ramus externus sinister.*
13. ARTERIÆ CAPSULARES.
14. ARTERIÆ RENALES, VEL EMULGENTES.
 A. *Rami capsulares inferiores.*
15. ARTERIÆ SPERMATICÆ.
17. ARTERIÆ LUMBALES.
 A. *Rami spinales.*
 B. *Rami posteriores.*
 C. *Rami anteriores.*
18. ARTERIA SACRA MEDIA.
19. ARTERIÆ ILIACÆ COMMUNES.
19. ARTERIA ILIACA INTERNA.
 A. *Ramus ilio lumbalis.*
  *a.* Ramulus ascendens.
  *b.* Ramulus descendens.
  *c.* Ramulus externus.
 B. *Ramus sacri lateralis.*
  *a.* Ramuli posteriores.
  *b.* Ramuli interni.
 C. *Ramus hæmorrhoidalis medius.*

D. *Rami vesicales.*
E. *Ramus umbilicalis.*
F. *Ramus uterinus.*
G. *Ramus vaginalis.*
H. *Ramus obturatorius.*
    *a.* Ramuli interni.
    *b.* Ramuli externi.
I. *Ramus gluteus.*
    *a.* Ramulus superficialis.
    *b.* Ramulus profundus.
        *α.* Ramusculus nutritius.
        *β.* Ramusculi superiores.
        *γ.* Ramusculi medii.
        *δ.* Ramusculus inferior.
K. *Ramus ischiadicus.*
    *a.* Ramulus coccygeus.
    *b.* Ramulus comes nervi ischiadici.
    *c.* Ramuli musculares.
L. *Ramus pudicus internus.*
    *a.* Ramuli hæmorrhoidales externi.
    *b.* Ramulus perinæi.
    *c.* Ramulus transversalis perinæi.
    *d.* Ramulus corporis bulbosi, vel spongiosi urethræ.
    *e.* Ramulus corporis cavernosi penis.
    *f.* Ramulus dorsalis penis.
19. ARTERIÆ ILIACÆ EXTERNÆ.
  A. *Ramus epigastricus.*
  B. *Ramus circumflexus ilii.*
    *a.* Ramulus anterior.
    *b.* Ramulus posterior.
19. ARTERIA FEMORALIS.
  A. *Ramus epigastricus superficialis.*
  B. *Ramus pudicus superficialis.*
    *a.* Ramulus superficialis.
    *b.* Ramulus profundus,
  C. *Ramus circumflexus ilii superficialis.*
  D. *Ramus profundus femoris.*

    *a.* Ramulus circumflexus externus.
        *α.* Ramusculi ascendentes.
        *β.* Ramusculi transversales.
        *γ.* Ramusculi descendentes.
    *b.* Ramulus circumflexus internus.
        *α.* Ramusculus ascendens.
        *β.* Ramusculus descendens.
    *c.* Ramulus perforans primus.
    *d.* Ramulus perforans secundus.
    *e.* Ramulus perforans tertius.
  E. *Ramus anastomoticus magnus.*

19. ARTERIA POPLITEA.
  A. *Ramus articularis superior internus.*
  B. *Ramus articularis superior externus.*
  C. *Ramus articularis medius, vel azygos.*
  D. *Ramus articularis inferior internus.*
  E. *Ramus articularis inferior externus.*
  F. *Ramus tibialis posticus.*
    *a.* Ramulus peroneus.
        *α.* Ramusculus peronæus posterior.
        *β.* Ramusculus peronæus anterior.
    *b.* Ramulus plantaris internus.
    *c.* Ramulus plantaris externus.
        *α.* Ramusculi perforantes.
        *β.* Ramusculi digitales.
  G. *Ramus tibialis anticus.*
    *a.* Ramulus recurrens.
    *b.* Ramulus malleolus internus.
    *c.* Ramulus malleolus externus.
    *d.* Ramulus tarsalis.
    *e.* Ramulus metatarsalis.
    *f.* Ramulus communicans.
    *g.* Ramulus pollicis.

# LECTURE XXVIII.

THE veins are the vessels which convey the blood, that has not been expended in secretion and nutrition, back again to the heart; they therefore differ from the arteries in commencing from every part of the body, and terminating at the heart, from whence the arteries commence. It may also be observed, that the veins are more numerous than the arteries; and generally two or more accompany each arterial ramus, and minuter distribution: besides which there are others, that take their course superficially, unaccompanied by the arterial system.

In the description of the veins, I shall commence with the ramifications, which unite to terminate in venous ramusculi, ramusculi in ramuli, ramuli in rami, rami in veins, and veins in seven terminating trunks which open into the heart. There are besides these, however, the sinuses of the brain, and the vena portæ of the liver, which have peculiar distributions, and are described with the organs to which they belong.

The four pulmonary venous trunks, which arise by minute ramifications within the lungs, and terminate in the left auricle of the heart, into which they convey the decarbonised blood, have already been described in the descriptive anatomy of the organs of respiration. (*Vide* p. 186, Vol. III.) We have therefore now to consider the origins and formation of the coronary, superior cava, and inferior cava, which are the three remaining venous trunks.

The blood which is conveyed to the substance of the

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heart by the coronary arteries, is returned by one venous trunk—

*Vena coronaria.* — The ramifications which commence from the termination of the coronary arteries, collect themselves into rami venosi, and take their course with the superior and inferior coronary rami of the right and left coronary arteries, where they may indeed be described as right and left venous coronary rami; but they then proceed along the base of the heart; and ascending in the groove which separates the auricles from the ventricles, they unite to form one trunk, which terminates in the right auricle, above and to the left of the auriculo ventricular opening, between it and the fossa ovalis, being there furnished with a valve.

### Of the Veins which form the Superior Cava.

This venous trunk conveys back again the blood which has been distributed from the heart, to the head, neck, upper extremities, and part of the chest, by the arteries sent off from the arch of the aorta.

The blood is returned from the head and neck by two venous rami: namely, ramus venosus jugularis internus, and externus.

*Ramus venosus jugularis internus*—extends from the fossa jugularis of the temporal bone, downwards to the lower part of the neck, where it terminates by uniting with the subclavian ramus to form the vena innominata; on the right side, it descends nearly perpendicularly to the vena cava; and on the left, it almost forms a right angle. In this course the ramus jugularis internus passes within the carotid sheath, on the outer side of the common carotid artery and pneumo-gastric nerve. It receives, above, the sinuses which return the blood from the brain, and which pass out of the foramen laceram basis cranii on either side, and terminates in the commencement of this ramus at the fossa jugularis. It then receives the ramulus venosus facialis, which conveys the blood back towards the heart which had been distributed by the ramulus maxillaris, arteriæ

carotidis : therefore to comprehend the manner in which the
blood of this ramulus is collected, it is only necessary to
refer to the distribution of the external maxillary arterial
ramulus, when it will be seen that the accompanying venous
ramuli are, ramusculi venosi angulares, r. v. laterales nasi,
r. v. labialis superior, et inferior, r. v. masseteres, r. v. sub-
mentales r. v. glandulares, r. v. tonsillares, and r. v. pallati
inferiores : these uniting, form the ramulus venosus facialis,
which is directed obliquely downwards and backwards, over
the horizontal plate of the lower jaw, covered by the pla-
tysma myoides muscle; and being placed between it and
the submaxillary gland, and behind and to the outer side of
this gland, it terminates in the ramus venosus jugularis
internus.

*Ramulus venosus lingualis*—collects its blood from the
ramusculi venosi ranini, r. v. sublingualis, r. v. dorsalis
linguæ, and r. v. hyoidei, and descends between the sub-
lingual gland and the genio glossus muscle; then between
the hyo glossus and mylo hyoideus muscles; passes back-
wards and outwards, accompanying the arterial ramulus
above the cornu of the os hyoides, to terminate in the internal
jugular ramus venosus.

*Ramulus venosus thyroideus superior*—receives its blood
from the ramusculi venosi thyroidei, r. v. laryngei, and r. v.
hyoidei : it then takes its course not unfrequently in two
ramuli, with the arterial ramusculus ; and terminates, either
singly or separately, in the internal jugular. Some ve-
nous ramusculi from the pharynx usually will be found
forming a single ramulus venosus pharyngeus, which emp-
ties itself in the internal ramus venosus jugularis.

*Ramuli venosi occipitales*—collect their blood from the
corresponding arterial vessels, following their course so
completely as to need no farther description. They termi-
nate in the internal ramus venosus jugularis.

Besides these venous ramusculi, others arise within the
diploe of the bones of the skull, which pass indirectly
into the internal jugular ramus: for instance, in front,

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by the frontal ramusculi venosi of the facial ramulus; behind, by the ramusculi venosi of the occipital ramulus, and in part by the sinuses of the brain: thus completing the ramus venosus jugularis internus.

*Ramus venosus jugularis externus*—is formed by the venous ramusculi, which return the blood from the face and sides of the head, and which had been conveyed by the terminating ramusculi of the external carotid arterial ramus.

*Ramulus venosus temporalis superficialis*—receives the blood of the ramusculi venosi temporales posteriores, r. v. temporales superiores, r. v. profundi temporales, r. v. transversales facii, r. v. articulares, and r. v. parotidei; it then descends in front of the ear, receiving some ramusculi venosi auriculares anteriores, and unites with the—

*Ramulus venosus maxillaris internus.*—This ramulus is made up of the ramusculi venosi nasales, r. v. palati superiores, r. v. infra orbitales, r. v. dentales, r. v. temporales profundi posteriores, r. v. pterygoidei, r. v. buccales, r. v. capsulares, and r. v. maxillares inferiores, and passes behind the cervix of the lower jaw, in the substance of the parotid gland, and there unites with the last described ramulus, forming together the commencement of the ramus venosus jugularis externus—which very frequently immediately receives the ramusculi auricularis posteriores, and then descends along the side of the neck, being placed between the sterno-cleido mastoideus and platysma myoides muscles. It next passes, rather deeper seated, behind the omo hyoideus muscle, and parallel with the outer edge of the sterno-cleido mastoideus; usually behind which it opens in the ramus venosus subclavius, to the outer side of the termination of the ramus venosus jugularis internus. In this course, several cervical cutaneous ramusculi empty themselves into this ramus, more especially at the lower part of the neck, just before its termination.

At the angle of the jaw, a short but large ramulus venosus passes deeply inwards, to form an anastomosis between the external, and internal jugular rami.

It should be observed, that each of the ramusculi which are distributed from the internal maxillary arterial ramulus are not furnished with a corresponding venous ramusculus: for instance, the blood which is conveyed to the membranes of the brain by the ramusculus arteriosus meningeus medius, is not returned to the ramus venosus jugularis externus by a corresponding venous ramusculus, but is conveyed from the membranes of the brain by the sinuses.

*Ramus venosus subclavius.* — This ramus conveys the whole of the blood from the upper extremity; but we shall find that the ramuli which unite to form it, do not all take the course of the arterial ramuli; but many of them are much more superficial, and indeed subcutaneous. We will, therefore, first describe the venous distribution which accompanies the arteries of the upper extremity, beginning at the fingers.

*Ramusculi venosi digitales*—accompanying each digital ramusculus of the arterial system—take their course upward to form the superficial palmar ramuli accompanying the superficial palmar arterial arch, and receiving venous ramuli from all the ramusculi of that as well as of the deep palmar arterial distributions. These all concur to produce—

*Rami venosi profundi radiales, et ulnares*—which take their course with the arterial rami; receiving, as they pass upward toward the elbow-joint, all the venous ramuli which return the blood from the corresponding arterial distributions; so that, near the elbow-joint, they form four considerable vessels; but having reached that joint, the two radial unite, and the two ulnar venous rami unite, forming two large veins—

· *Venæ brachiales.*—These take their course on either side of the brachial artery frequently anastomosing with each other, and receiving venous rami which are corresponding with the arterial rami: as for instance, rami venosi anastomotici magni, r. v. profundi inferiores, and r. v. profundi superiores. The venæ brachiales thus augmented in size as they pass upward, reach the inferior edge of the teres major

muscle, and form in part the vena axillaris, which has also to receive the superficial venous distribution of the upper extremity, as well as the venous rami, accompanying the arterial rami from the axillary artery.

*Ramus venosus cephalicus*—commences by a number of venous ramusculi on the back of the hand, and particularly about the thumb; upon which so large a branch is found, that it has been named the *ramulus venosus magnus pollicis*. These collect and take their course upward upon the outer and anterior part of the fore arm, parallel with the radius, and is here named the *ramulus venosus radialis superficialis*, which receives numerous subcutaneous venous ramusculi; and on reaching the bend of the elbow it unites with the median cephalic ramulus — together forming the above-named ramus venosus cephalicus, which now ascends vertically parallel to the outer edge of the biceps muscle, then between the outer edge of the pectoralis major, and the inner edge of the deltoid: it terminates by bending inwards under the clavicle, to open into the axillary vein.

*Ramus venosus basilicus*—is formed in a similar manner as the last described ramus, by venous ramusculi commencing on the inner side of the hand. On the back and inner side of the hand, and posterior surface of the fingers, a net-work of ramusculi is formed, the vessels of which frequently anastomose with each other, as well as with the cephalic ramusculi. On reaching the upper part of the hand, these ramusculi frequently form one large vessel, which has been termed the *vena salvatella*, which continues to the inner and back part of the fore arm, and gains the name of the—

*Ramulus venosus ulnaris superficialis posterior.*—This ramulus continues its course upwards behind the inner condyle of the humerus, where it is connected with the anterior superficial ulnar ramulus; receiving, however, previous to this union, numerous subcutaneous ramusculi.

*Ramulus venosus ulnaris superficialis anterior*—originates at the lower part of the inner and anterior part of the

fore arm; ascending in front of the ulna, before the internal condyle, to communicate with the last described ramulus. Just above the bend of the elbow, and the union of the posterior and anterior superficial ulnar ramuli, the ramulus basilicus medianus unites, and they together form the ramus basilicus.

The median basilic ramulus, below the bend of the elbow, and in the triangular space between the supinator radii longus on the outer side, and the pronator radii teres muscle on the inner, unites with the median cephalic, at an acute angle: both of them emanating from a vessel named—

*Ramulus venosus medianus.*—The ramus venosus basilicus then ascends along the inner side of the arm, in front of the ulnar nerve, receiving small subcutaneous ramusculi in its course upwards; anastomosing also with the ramus venosus cephalicus, it passes deeply into the axilla, where it terminates in the—

*Vena axillaris*—This vein ascends obliquely inwards and upwards, under the clavicle in front of the axillary artery, as high as the first rib, where it becomes the subclavian vein. In this course it receives, however, rami corresponding to the rami of the axillary artery: such as rami venosi circumflexi, r. v. inferiores scapulæ, and the r. v. thoracici. From the anterior edge of the first rib the subclavian vein commences; and extends inwards in front of the scalenus anticus muscle, to terminate within the thorax, (after having received the rami jugulares), in forming the superior cava.

In consequence of the situation of the superior cava on the right side of the chest, there is a considerable difference both in the extent, and direction of the two subclavian veins: the right subclavian vein is very short, and is directed nearly in a vertical direction: it is covered by the sterno cleido mastoideus muscle, sterno clavicular articulation, and the cartilage of the first rib. To its outer side it is bounded by the pneumo gastric nerve, the right subclavian artery, and the scalenus anticus muscle; internally it is bounded by the aorta.

The left subclavian vein is nearly twice the length of the right, and its direction is nearly horizontal, having a slight obliquity downwards and inwards. It is covered, like the right subclavian vein, by the sterno-cleido mastoideus, the sterno clavicular articulation, and the cartilage of the first rib; also by the first bone of the sternum, the sterno-hyoidei and sterno-thyroidei muscles. It is bounded posteriorly by the scalenus anticus muscle, the left subclavian artery, the pneumo gastric nerve, and the arch of the aorta. It is, in fact, the most anterior of all the vessels seen within the cavity of the chest. The left subclavian vein usually receives two venous rami which the right does not, and which we will proceed to describe before those common to both veins.

*Ramus venosus mammillaris internus sinister*—returns the blood which the corresponding arterial ramus had distributed: it is made up, therefore, of ramuli venosi abdominales, r. v. diaphragmatici, r. v. comites nervi phrenici, and r. v. intercostales. These are collected into a single ramus, which takes its course upwards upon the posterior surface of the cartilages of the ribs; and as it reaches the left subclavian vein, it is directed backwards to terminate in it.

*Ramus venosus thyroideus inferior sinister*—results from the union of numerous ramuli which pass out of the inferior and posterior surface of the thyroid gland, and descend in front of the trachea, upon which they enter the chest, and terminate in the left subclavian vein.

The remaining rami to be described, are common to both subclavian veins, and are the vertebral and superior intercostal rami.

*Ramus venosus vertebralis*—is made up of ramuli corresponding to the distributing ramuli of the arterial ramus. It commences principally by small ramuli from muscles in the occipital and posterior cervical regions, and there forms itself into a large trunk, which takes its course with the vertebral artery upon the posterior circular ligament between the atlas and occiput; it passes forwards to gain the

foramen at the root of the transverse process of the atlas, near to which it is united with the lateral sinus of the dura mater, by a venous ramulus, which passes through the posterior condyloid foramen. The ramus venosus vertebralis then descends through the canal formed by the transverse processes of all the cervical vertebræ, being accompanied by its corresponding artery. In this course it anastomoses internally, through the intervertebral foramina with the sinus venosus; and externally, it receives in each intervertebral space, venous ramuli from the muscles of the neck. This ramulus issues from the canal of the seventh cervical vertebra, and descends by the side of its accompanying arterial ramulus, between the rectus capitis anticus major on its inner side, and the scalenus anticus on the outer. In this space receiving venous ramuli returning the blood from the ramulus cervicalis profundus; then it passes, on the left side before the subclavian artery, and on the right side behind that vessel, to terminate in the subclavian vein.

*Ramus venosus intercostalis superior dexter*—is very small, and sometimes wanting; it commences by corresponding ramuli of the superior right arterial intercostal ramus, from the two or three upper intercostal spaces, which uniting, form one ramus, opening into the right subclavian vein.

*Ramus venosus intercostalis superior sinister*—is always much larger than the right, commencing by ramuli as low down as the eighth intercostal space; it enlarges as it ascends, anastumosing with the vena azygos, and receiving venous ramuli from each intercostal space above the eighth; it passes on the sides of the bodies of the vertebræ behind the pleura, behind the lung and aorta; and near to the third cervical vertebra, just to the outer side of the arch of the aorta, it receives—

*Ramulus venosus bronchialis sinister*—immediately after which, it passes out of the chest, and terminates in the under part of the left subclavian vein. That portion of the subclavian veins, included between the entrance of the internal

jugulars and their termination in the superior cava, has by
some anatomists been termed the venæ innominatæ; so that
the formation of the superior cava would be considered as
resulting from the union of the two venæ innominatæ; and
by others, by the union of the two venæ subclaviæ.

*The vena cava superior*—formed as we have described it,
commences opposite to the cartilage of the first rib on the
right side, to the right and rather above the arch of the
aorta; from thence it descends to terminate in the right
auricle of the heart, passing obliquely downwards and in-
wards; but before it reaches the heart, it enters the peri-
cardium; by which it gains a distinct serous covering. This
venous trunk is bounded anteriorly, by the anterior medi-
astinum, and its contents; posteriorly, by the superior right
pulmonary vein, and right pulmonary artery; to the right,
by the lung; and to the left, by the ascending aorta. In
this course, before entering the pericardium, it receives the
following venous rami.

*Ramus venosus mammillaris internus dexter.*—The de-
scription of this ramus corresponds in every circumstance
with that of the left side, excepting in its terminating in the
cava, instead of the subclavian vein.

*Ramus venosus thyroideus dexter.*—This branch results
from the union of the thyroid venous plexus, just in the
same manner as on the left side, and passes downwards in
front of the subclavian artery; takes its course to the right,
behind the sterno-hyoidei and sterno-thyroidei muscles, to
terminate in the upper part of the superior cava, between
the two subclavian veins.

*Ramus venosus azygos*—results from the union of ten or
eleven of the intercostal venous ramuli of the right side,
and the five or six inferior of the left, communicating below
with one of the superior lumbar veins—thus producing a
communication between the superior and inferior cavæ.
Commencing the description of this ramus from the ab-
domen, it passes upwards between the pillars of the dia-
phragm, in the same opening with the aorta and thoracic

duct; it ascends upon the bodies of the vertebræ within the posterior mediastinum, to the right of the aorta and thoracic duct, and in front of the right intercostal arteries. Having reached the third dorsal vertebra, it bends backwards behind the arch of the aorta, directs itself to the right, passes behind the right bronchus, above which it rises, passes forwards and downwards so as to hook around the bronchus, and terminates in the superior cava.   In this course, it receives, first, within the abdomen, as has been mentioned, some venous lumbar ramuli from the inferior cava, or from the renal vein; while in the chest, on the dorsal vertebræ, it not only receives all the rami venosi intercostales of the right side, but upon the seventh dorsal vertebræ, there opens into it—

*Ramus semi-azygos*—a branch made up of the six inferior left intercostal ramuli, which crosses the eighth dorsal vertebra from left to right, behind the aorta and œsophagus, receiving venous ramuli from each of these organs; and, lastly, just before it opens into the superior cava, it receives the—

*Ramus venosus bronchialis dexter.*—This ramus is made up of numerous small ramuli, proceeding from the right lung, œsophagus, trachea, pericardium, and bronchial glands—thus completing the formation of the superior cava.

*Of the Venous Distributions which concur in forming the Trunk of the Vena Cava Inferior.*

This trunk returns the blood to the heart which has been distributed by the abdominal aorta, with the exception of that portion, which is returned from the chylopoetic viscera, by the vena portæ.

As in the upper extremity, the veins of the lower are divided into two sets—one following the course of the arteries, and the other being subcutaneous. I shall therefore describe them in a similar order.

First, the deep veins commence in the foot, bearing the same names as the arterial ramusculi which they accom-

pany. Thus the ramusculi venosi digitales, and ramusculi venosi perforantes, unite to form the *ramuli plantares.* They take their course backwards, from the foot to the internal malleolus; where they unite, and form the *ramus venosus tibialis posticus.* This takes its course upwards with the artery, to gain the popliteal space, where it terminates in the popliteal vein. In its course along the leg, it receives the *ramuli venosi peronei posteriores, et anteriores.*

From the fore part of the dorsum of the foot, ramuli venosi pollicis, r. v. communicantes, r. v. metatarsales, r. v. tarsales, r. v. malleoli externi, et interni, and r. v. recurrentes, together contribute to form the *rami venosi tibiales antici;* for there are two which accompany the artery—taking its course upon the anterior surface of the interosseous ligament, and ascending as high as the upper hiatus; then pass through it with the artery, and terminate in the popliteal vein.

The popliteal vein also receives the following superficial subcutaneous venous ramus.

*Ramus saphenus externus* — commences by numerous ramuli from the outer side and back part of the foot, which ascend both anterior, and posterior to the malleolus externus, and unite above it in a single trunk, which directs itself to the posterior part of the calf of the leg ; passing vertically upwards, between the integuments and fascia, gains the interspace between the two heads of the gastrocnemius muscle ; then passes into the hollow of the ham, and terminates in the popliteal vein.

*Vena poplitea*—takes its course with the popliteal artery, being placed behind and to its outer side, and extends with it from the lower edge of the popliteus muscle to the tendinous sheath formed by the vastus internus and adductor magnus ; at which point, this vein, as well as the artery, terminate by becoming femoral.

In this course, the popliteal vein receives also the five sets of *ramusculi venosi articulares.*

*Vena femoralis*—commences from the termination of the popliteal, as above described, and passes upwards to

Poupart's ligament, taking the course of the femoral artery, and terminates by becoming the external iliac vein. In this course, it receives the deep branches which accompany the arteries; namely, rami venosi anastomotici magni, ramuli venosi perforantes tertii, secundi, et primi, r. v. circumflexi externi et interni; ramus venosus profundus femoris, rami pudici superficiales, and rami venosi epigastrici superficiales. But besides these deep veins, it also receives—

*Ramus venosus saphænus internus.*—This commences by numerous ramuli upon the inner, back part, and dorsum of the foot, which form anastomoses with the ramus saphænus externus; the ramifications unite, pass upward, surrounding the malleolus internus, receiving tarsal ramuli, and then form a single ramus above the ankle, which ascends obliquely upwards and backwards along the inner side of the leg, passes behind the internal condyle of the femur to gain the thigh, from whence it passes upwards upon the inner side of the thigh, anterior to the adductors, and gracilis muscle, receiving numerous superficial cutaneous ramuli from the posterior part of the thigh, more especially upon the fore part of the internal condyle, where large vessels are seen to connect themselves with this ramus. The ramus saphenus continues to ascend, between the skin and fascia on the inner and fore part of the thigh, as high as the crescentic margin of the fascia lata; and here it perforates the fascia propria, or anterior layer of the sheath of the femoral vessels, to terminate in the femoral vein.

The ramus saphenus, just before it terminates, receives some small superficial ramuli from the abdomen, and from the superficial pudic venous distribution.

The *vena iliaca externa*—commence at the termination of the femoral vein at Poupart's ligament, and extends upwards to the sacro-iliac symphysis, where it terminates in the common iliac vein. In this course, it accompanies the external iliac artery, which is anterior and to the outer side of it. It receives the rami venosi circumflexi ilii, and the rami venosi epigastrici, formed by ramuli accompanying the distributions

of the corresponding arteries : also a branch of considerable size in the male subject, which passes out of the inguinal canal, through the internal ring ; which vessel seems to correspond with the arterial ramification from the epigastric, which supplies the cremaster muscle.

*Vena iliaca interna, vel hypogastrica.*—The venous rami which unite to form this vein, may be divided, as the ramifications of the corresponding artery, into those which return the blood from the muscles within the pelvis, those from the viscera within the pelvis, and from the parts without the pelvis.

The first order constitutes the rami venosi sacri-laterales, and the rami venosi ilio lumbales. The second order are the rami venosi vaginales, r. v. uterini, r. v. umbilicales, r. v. vesicales, and ramus hæmorrhoidalis medius. The third order are the rami venosi glutei, the r. v. pudici externi, the r. v. ischiadici, and the r. v. obturatores ; which are severally produced from the venous ramifications, corresponding to the respective arterial distributions.

These three orders unite, and form a short large vein, placed in the hollow of the pelvis, behind its corresponding artery ; and just at the upper part of the sacro-iliac symphysis, it unites with the external iliac vein, which has already been described, to form the—

*Vena iliaca communis.*—There is some little anatomical distinction between the right and left iliac veins ; although they are both resulting from the union of the external and internal iliacs.

The left common iliac vein, in passing upwards and to the right to terminate in the inferior cava, has a longer course to run than the vein on the right side, is also more obliquely placed, and has to pass behind the right common iliac artery.

These veins extend from the sacro-iliac symphysis, upwards, to the junction between the fourth and fifth lumbar vertebræ, where they unite to form the trunk of the inferior cava ; in this course, receiving only some few unimportant venous rami.

The *vena cava inferior, vel abdominalis*—extends from
the junction of the fourth and fifth lumbar vertebræ, to the
right auricle of the heart, in which it terminates. In this
course, it ascends vertically on the right side of the bodies
of all the lumbar vertebræ ; being first covered by the right
common iliac artery, then by the reflections of the perito-
neum, then by the duodenum, and then passes behind the
liver, in a groove in that organ, between the right lobe, and
the lobulus spigelii ; it next perforates the cordiform tendon
of the diaphragm, and entering the thorax, it is covered by
the pericardium, and almost immediately enters the auricle
of the heart by an aperture bounded by the eustachian valve.
It is placed to the right of the aorta, and in this course
receives the following venous rami.

*Venæ sacræ mediæ*—correspond with the arterial rami-
fications, pass upward upon the anterior surface of the os
sacrum, and terminate in an angle resulting from the union
of the two common iliacs into the cava.

*Venæ lumbales*—are four in number on each side, and each
results from four rami venosi anteriores, posteriores et spi-
nales ; they anastomose, above, with the intercostal venous
rami, and below, with the ramus venosus circumflexus ilii.
Those of the left side, are much longer than those of the
right, and pass behind the aorta. These veins frequently
anastomose with each other on the fore part of the trans-
verse processes of the lumbar vertebræ.

*Vena spermatica dexter*—terminates in the abdominal
cava, but on the left side it opens into the left emulgent
vein. These veins commence in the male upon the tunica
vasculosa of the testicle, form the spermatic plexus of veins,
pass upward upon the spermatic cord in four or five distinct
branches, enveloping the spermatic artery, and vas deferens,
pass through the external abdominal ring, inguinal canal,
and internal abdominal ring, and then unite and form a single
vein which takes its course upwards along the psoas muscle,
and approaches the kidney, where it receives veins from the
renal plexus ; from this, however, the spermatic vein conti-

nues its course to terminate, as has been described, on the right side in the cava, and on the left, in the emulgent vein. In the female, the spermatic veins commence from the ovaria, from whence they pass to terminate in a similar manner.

*Venæ renales, vel emulgentes*—are of great size, but not so large in proportion to their arteries as other veins. They result from the union of ramifications, corresponding with the distributions of the renal arteries; and unite to form one trunk, in the fissure of the kidney; from whence it passes, transversely inwards, to open into the inferior cava. The left emulgent vein is longer than the right, and has to cross in front of the aorta to gain the cava; it also differs from the right in receiving the left spermatic vein. Both renal veins receive the inferior rami venosi capsulares.

The *rami venosi medii capsulares* — arising from the capsula renales, are uncertain in their termination, but very generally open into the cava, and more particularly on the right side.

The *venæ diaphragmaticæ*—result from the venous ramifications, corresponding to the arterial distribution, and terminate in the cava.

The *venæ hepaticæ*—commence within the substance of the liver, and collect themselves into a right and left hepatic vein, corresponding to the two lobes. They pass out from the organ at its obtuse edge, between the two layers of the lateral ligaments, and open into the cava between the diaphragm and the liver. Between the right and left hepatic vein, generally two or three smaller veins, which have been named the middle hepatic veins, also pass out to terminate in the cava; and thus complete the sources which contribute to the formation of the ascending or inferior cava, which then passes through the cordiform tendon of the diaphragm, and having entered the thorax, immediately opens into the right auricle of the heart. The only remaining veins to be described, are—

*Ramuli venosi spinales, vel sinus vertebrales*—take the course of the whole of the vertebral canal, from the sacrum.

to the occiput, behind the bodies of the vertebræ, anterior to
the theca vertebralis, and on the sides of the common proper
posterior ligament.   They commence from the venous ra-
musculi in the adipose tissue of the sacral canal, and are
augmented by ramusculi from the dura mater, enveloping the
spinal marrow along the whole length of the spinal column.
In this course they anastomose with the venous ramusculi
of the lateral sacral, lumbar, and intercostal rami, on their
outer sides ; and on their inner sides, by short vessels with
each other, on the bodies of the vertebræ, underneath the
posterior vertebral ligament, where they receive ramusculi
from the substance of the bodies of the vertebræ.

These ramuli venosi are called sinuses, because they have
short communicating cross-tendinous bands in them, similar
to the sinuses of the dura mater.   They communicate with
the rami jugulares interni, opposite to the anterior condyloid
foramina.

The ramuli venosi spinales, appear to contract opposite to
the fibro-cartilages, and to enlarge upon the bodies of the
vertebræ, hence they have a knotted appearance, which is
more particularly observable in the lumbar region.

The diseases of veins, in a surgical point of view, are less
important than those of arteries, rarely leading to operations;
their frequent communications by collateral branches being
the means of restoring the circulation under any interruption
to the current of the refluent blood.   I therefore do not deem
it necessary to enter farther into this subject than I have
already done.   (*Vide* Vol. III. p. 296.)

# LECTURE XXIX.

THIS system consists of the absorbent glands, and the absorbent vessels. Anatomists have considered the latter under the two names of lymphatics and lacteals: terms which in fact merely imply the appearance of their contents; nor indeed do we know any difference, either in their organization or functions, further than that the lacteals convey to the blood the products of digestion, while the lymphatics remove from every part of the body (excepting from the exterior), the excrementitious particles of the system, which is subjected to the action of the lungs, to be fitted for future circulation.

In the physiology of the absorbent system, we have mentioned the general structure and the termination of the absorbents, with their mode of passing over, in, and out, of the absorbent glands (*vide* Vol. III. p. 283); and we remarked, that it appeared to be a law of the animal economy, that the fluids circulated in these vessels should be submitted to the action of the glands, previous to their admission to the circulation of the blood. Whatever the peculiar action of the glands may be, their situation is of great importance to the surgeon, on account of the extensive connection which they frequently hold with the progress of diseases.

Anatomists have usually described the absorbents in sets, conformable to the general course which they appear to take. Following this order, we shall first enumerate the absorbent glands in the different situations of the body in which they are to be found, and then proceed to the course

which the absorbent vessels take to be connected with them.

*Absorbent glands of the head.*—No absorbent gland has been discovered within the cranium ; for no absorbent vessel has been traced either to or from the pituitary, pineal, or Pacchionian glands. Two or three absorbent glands are found beneath each ear, and one or two behind the zygomatic arch.

*Absorbent glands of the face.*—There is generally one situated on the buccinator muscle, and one or two above the parotid gland, and others along the under edge of the lower jaw, lying in the course of the digastric muscle.

*Absorbent glands of the neck.*—Here the superficial and deep-seated arrangement is more distinct. The superficial are placed immediately under the platysma myoides muscle, in the course of the external jugular vein. The deep-seated are placed in the course of the internal jugular vein, and carotid arteries ; and form a chain, from the mastoid process to the upper opening of the thorax, covered by the sterno-mastoid muscle.

These glands are more numerous than in any other situation in the body, excepting the mesentery, and have been named the glandulæ concatenatæ jugulares. There are also one or two near the larynx, a few at the back of the neck, and some smaller ones in the space between the clavicle, the sterno-mastoid, and trapezius muscles.

*Absorbent glands of the upper extremity.*—It is very unusual to find any gland below the elbow—one or two small ones are found near the inner condyle ; from this point five or six are met with at intervals, along the course of the brachial artery.

In the axilla they are much more considerable, both in size and number. They are here embedded in the cellular membrane of the axilla, in connection with the axillary blood-vessels, and nerves. These glands, five or six in number, are connected with others, which extend behind the clavicle, and beneath the pectoralis major.

*Absorbent glands of the thorax.*—Three or four are found of small size, before the inferior part of the pericardium, above the diaphragm. From four to five are also found at the superior and anterior part of the anterior mediastinum: from six to ten, in the course of the internal mammary artery. Several are placed between the layers of the posterior mediastinum, behind the pericardium, in the whole course of the œsophagus: others forming a chain, which appears to continue from the lumbar glands, are placed along the dorsal vertebræ, and between the posterior extremities of the ribs.

*The bronchial glands.*—These are numerous, of a dark color in old subjects, and follow the course of the first division of the bronchial tubes, and the interval between the lungs. They vary in size; are sometimes single, at others lobulated. They are filled with a dark fluid; and it is not uncommon to find them filled with chalky concretions.

Some of these glands are situated about the arch of the aorta, between it and the pulmonary artery, where they have been named the cardiac glands—receiving the absorbent vessels of the heart.

*Absorbent glands of the lower extremities.*—The only gland met with below the knee, is one placed at the upper hiatus of the interosseous ligament, between the tibia and fibula; named the anterior tibial gland. In the popliteal region, three or four accompany the popliteal artery. In the inguinal region, there is a superficial and a deep-seated set: the superficial are placed between the fascia lata and skin, near the termination of the saphæna major vein—they are from six to twelve in number, placed close together; the deep-seated, two or three in number, are placed under the fascia lata, and close to the femoral artery.

### Absorbent Glands of the Pelvis.

' *The internal iliac glands*—are from eight to ten in number, following the course of the internal iliac vessels, on the inner side of the cavity of the pelvis. Sometimes one or

two are also found in the course of the gluteal, and ischiatic rami.

The *external iliac glands*—from six to ten in number, are situated in the course of the external iliac vessels; some between them and the psoæ muscles, others on the internal side of these vessels. Inferiorly, they extend to the crural arch, and upwards to the glands of the lumbar region; the intervening two or three glands, which connect the external iliac with the lumbar, are placed in the tract of the common iliac arteries.

· *Sacral glands*—are two or three, placed between the sacrum and the rectum, within the layers of the meso-rectum.

*Absorbent glands of the abdomen*—are more numerous than in any other part of the body, being connected with the extensive absorption of the alimentary canal, and viscera contained within this cavity. They are named according to their connection with these various organs.

The *mesenteric glands*—from one hundred and thirty to one hundred and forty in number, are situated between the layers of the mesentery, arranged at short intervals from each other, occasionally in clusters. They are most numerous in the mesentery of the upper part of the jejunum, decreasing in number downwards. They are seldom larger than an almond—the largest being nearest to the roots of the mesentery.

The *meso-colic glands*—are connected with the colon, and follow the course of that intestine. They are less in size and number, than in the mesentery—five or six on the inner side of the ascending, thirty or more to the transverse arch, the largest of which are at the root of the meso-colon, the smallest at the posterior edge, and six or seven on the inner edge of the descending colon, and fifteen or twenty on the outer; while two or three are met with in the upper part of the meso-rectum.

The *ventricular glands*—are placed along the curvature of the stomach, in the course of the right and left inferior

gastric ramuli, the coronary ramus, and of the great, and little omentum. They are small in size, and from five to six in number.

The *cœliac glands*—variable in number, are situated in the course of the vena portæ, cœliac, and superior mesenteric arteries; they are divided into sets, accompanying the rami of the cœliac artery, and are called the hepatic, pancreatic, and splenic glands.

The *lumbar glands*—are large and numerous, accompanying the aorta and vena cava, forming a glandular series, covering the inferior part of the pillars of the diaphragm, and lumbar vertebræ.

### Of the Absorbent Vessels.

All the absorbent vessels of the body terminate in the veins, but principally into the venæ innominatæ, at the upper part of the chest, by two large trunks, termed the thoracic ducts. These are the main trunks to the absorbent system, as the aorta and venæ cavæ are to the arterial and venous systems. We shall therefore describe the absorbent vessels, as they pass to form these two terminating trunks in the course of their circulation.

It may be observed, however, that there is a great disparity between the right and left thoracic ducts; the right receiving the absorbents of the right half of the head and neck, of the right upper extremity, of the right half of the parietes and contents of the thorax, and some few only from the liver; while the left, or as it is often named from its larger size, the thoracic duct, receives the absorbents from all the other parts of the body.

This dissimilitude of distribution is not, however, so great as to lead to the necessity of separate descriptions, farther than the deviation which necessarily occurs in the course of the main trunks; as, generally, the mesian line of the body, in the head, neck, trunk, and extremities, is a line of separation to similar ultimate distributions.

*Of the absorbent vessels of the head and neck.*—The

superficial absorbents of the head and neck, may be divided
into those from the anterior, middle, and posterior parts of
the head and neck.

The *anterior*—arise from the cheeks, lips, inferior eye-
lid, nose, external surface of the eyelids, fat of the orbit,
and the forehead. They take their course with the veins
principally, and run toward the glands situated between
the anterior belly of the digastric muscle and the lower
jaw. Others arise from the mucous membrane of the mouth
and tongue, the mylo-hyoideus, and genio-hyoidei mus-
cles, the sublingual, and submaxillary glands, and pass
to glands at the base of the lower jaw. The vessels from
the anterior parts, take their course to the glands, above and
before the jugular vein; and thus pass to terminate in the
right and left sides, in their respective thoracic ducts.

The *middle* branches of the superficial absorbents—arise
from the summit and lateral parts of the cranium, accom-
panying the ramifications of the temporal artery; also from
the external parts of the palpebræ; and one branch from
the cheek accompanies the transverse facial ramusculus.
These enter the glands, situated before the ear, and below
the zygomatic arch; while those which accompany the
temporal ramuli, descend on the external part of the parotid,
to the same absorbent gland.

The *posterior* branches—arise from the posterior parts of
the head, taking the course of the posterior branches of the
temporal ramulus. The auricular and occipital ramusculi,
after forming numerous anastomoses, penetrate the glands
on the posterior part of the head and neck; they then de-
scend behind the sterno-cleido mastoideus; some branches
arising from the substance of that muscle, and pass to the
glands placed at the lateral and inferior part of the neck,
between the trapezius and sterno-cleido mastoideus, and to
those glands which are situated in the course of the jugular
vein, near to its bifurcation.

The *absorbent vessels, deeply seated in the head and neck*
—are arranged in an anterior and a posterior set.

The *anterior*—arise from the larynx, pharynx, and thyroid glands, accompanying the superior thyroideal, and ascending pharyngeal ramuli. They sometimes enter small glands on the upper and fore part of the thyroid, and cricoid cartilages, the superior thyroideal at the same time passing to glands situated on the fore part of the trachea.

The *posterior*—arise from the back part, and posterior muscles of the neck, accompanying the ascending ramusculus of the posterior cervical ramus; they enter glands, in the course of the internal jugular vein with the vessels of the anterior part.

The deep-seated absorbents of the cranium, have not been traced beyond the membranes of the brain; but there is no doubt that they exist, as the ventricles contain a fluid, which is constantly secreted and absorbed—the absorbents being the only vessels from which the latter effect may be supposed to arise. These absorbents pass out of the cranium with the blood-vessels, and join the superficial absorbents of the head and neck.

The trunks both of the superficial and deep-seated absorbents, freely communicate with each other, and with those from the chest and upper extremity; finally forming one, or more trunks, which terminate in the upper part of the thoracic duct, at the angle formed by the internal jugular and subclavian veins.

*Superficial absorbents of the upper extremity.*—These arise from the fingers, and ascend on the fore and back part of the hand, and fore arm, where they form a freely anastomosing plexus. They then pass over the muscles on the radius and ulna, to the inner and fore part of the arm, and are all situated anteriorly at the bend of the elbow; where they unite with three or four vessels, which ascend more particularly from the palm of the hand, and anterior part of the fore arm. They then pass through the glands above the elbow, and from thence on the inner side of the arm to the axilla, where they unite with the axillary glands. Some few accompany the cephalic vein, and reach the axilla by passing between the deltoid and pectoralis muscles.

*Deep-seated absorbents of the upper extremity.*—These accompany the arterial distributions, and are commonly two in number to each of the larger rami of the fore arm; they afterwards unite into trunks, which continue with the brachial artery, to terminate in the axilla—uniting freely with the superficial set.

*Absorbents of the parietes of the thorax*—arise from the anterior, lateral, and posterior parts, and are distributed in a superficial and deep-seated arrangement.

Of the *superficial.*—The anterior and lateral, arise from the corresponding parietes of the thorax, sending branches which unite with the absorbents of the cavity. They take their course, from the upper part, over the pectoralis major, and from the lower part and sides, over the serratus magnus and obliquus externus abdominis muscles, to reach the axilla; where they unite with the axillary glands. From the posterior part of the trunk, they take their course from the whole surface of the back—the greater number running over the trapezius muscle, through which they pass to the glands of the axilla.

The *deep-seated absorbents*—are the intercostals: they arise from the external muscles, and cellular tissue of the thorax; then pass deeply to the glands between the layers of the intercostal muscles, and then to the sides of the vertebral column, where they join with the absorbents of the spine, and muscles of the back; forming a plexus upon the vertebræ, and terminating obliquely in the thoracic duct.

### Absorbent Vessels of the Viscera, and parts within the Thorax.

*Absorbents of the lungs.*—These form a superficial and deep-seated set.

The *superficial*—are placed beneath the pleura, and form a considerable plexus, which surrounds the lungs, collecting their trunks toward the roots, where they terminate in the bronchial glands.

The deep absorbents—arise in the parenchyma of the substance of the lungs, accompanying the distribution of the veins, and uniting with the superficial set in the bronchial glands. From thence one or two large trunks proceed along the trachea; others pass to different ganglia, terminating in the thoracic duct by two trunks, and occasionally in the internal jugular, or left subclavian vein separately.

Absorbents of the diaphragm.—These form numerous trunks, which arise from the upper surface of the muscle, and pass to the glands of the anterior mediastinum, before they terminate in the thoracic duct.

Absorbents of the heart.—These are distributed in the course of the coronary arteries, forming two trunks; that with the right coronary artery, terminates in the superior part of the thoracic duct; while that with the left, continues obliquely between the aorta and pulmonary artery, traverses some neighbouring glands, and then enters either the internal jugular vein, or thoracic duct.

Absorbents of the pericardium, and thymus gland—arise in these organs, and collect in trunks, which enter the bronchial glands.

Absorbents of the anterior mediastinum—enter from the abdomen, passing behind the ensiform cartilage, take the course of the internal mammary rami, pass through numerous glands, and then terminate either in the thoracic duct, or right subclavian vein.

Absorbents of the lower extremity—are divided into a superficial and a deep set.

The superficial—take an anterior and a posterior course: the anterior set, arise by innumerable minute branches from the upper and fore part of the toes, and dorsum of the foot, where they form a plexus, surrounding the inner malleolus; and then direct themselves upward, along the inner and anterior part of the leg, taking the course of the saphæna major vein, as high as the inner side of the knee.

The posterior set—arise from the back part and sole of the foot, by three or four separate vessels, which unite with

each other at the outer malleolus, ascend along the tendo Achillis, at the back part of the leg, accompanying the external ramus venosus saphænus, as high as the ham; where they divide, partly to unite with the deep absorbents in the popliteal glands, and partly with the anterior super-ficial absorbent vessels; and together, take their course upward on the inner side of the thigh, with the ramus venosus saphæna major, to terminate in the superficial in-guinal glands.

The *deep-seated absorbent vessels*—are divided into three sets, and take their course with the arterial rami of the leg, receiving corresponding names.

*Anterior tibial absorbents*—are two in number; one of which arises from the sole of the foot, passing upwards with the ramulus arteriosus communicans of the anterior tibial ramus, upon the dorsum of the foot, and then accompanies that ramus; the other originates upon the outer side of the foot, and at the upper part of the dorsum; it also gains the anterior tibial ramus, and together pass upward, between the tibia and fibula. The first of these branches takes its course upwards, as high as the upper interosseous opening, and then partly terminates in the anterior tibial absorbent gland, and partly continues through the opening, to unite with the other deep absorbent vessels and popliteal glands. The second branch usually penetrates the interosseous li-gament about the middle of the leg, and unites with the fibular absorbents.

The *posterior tibial absorbents*—commence with the ultimate ramifications of the posterior tibial ramusculi in the sole of the foot, they pass upward, accompanying the blood-vessels, and enter the popliteal glands.

The *peroneal,* or *fibular absorbents*—arise in a similar manner, from the termination of the peroneal arterial ramus-culi, and pass upward, accompanying that blood-vessel, to enter the popliteal glands. All these deep-seated absorbents open, therefore, into the popliteal gland; but afterwards, as vasa deferentia, they form a plexus, from which three or four

vessels continue upward, in the course of the popliteal artery, with it pass through the tendinous sheath formed by the adductor magnus and vastus internus, and then continue with the femoral vessels, receiving the deep absorbents of the thigh as they ascend, and terminate by entering the deep inguinal glands. Some few vessels, however, pass upward into the pelvis, under the ligament accompanying the external iliac artery, and terminate in the inferior external iliac absorbent gland.

*Superficial absorbents of the lower part of the trunk.*— They arise from various sources, and are named respectively.

The *absorbents of the lateral and back parts of the pelvis* —arise from the cellular tissue of the nates, freely communicate with each other, and passing downward upon the anterior and posterior parts of the thigh, unite with the superficial absorbents of the perineum, and inferior extremity; and terminate in the superficial inguinal glands.

The *absorbents of the loins*—form in the loins, from the posterior part and sides of the vertebral column; they descend from the pelvis, and are connected with the superficial inguinal glands.

The *superficial absorbent vessels, from the middle and anterior parts of the abdomen*—form a plexus between the umbilicus and pubes, from which some vessels descend to enter the superficial inguinal glands.

*Absorbents* also arise from the *perineum, scrotum,* and *penis*—which ascend on the inner side of the thigh, uniting frequently with each other, and ultimately ramify in the superficial inguinal glands.

The *deep-seated absorbents of the lower part of the trunk.*—The obturator absorbents arise on the inner side of the thigh, from the termination of the obturator arterial ramus, ascend with that vessel, pass through the obturator ligament into the pelvis, and terminate in the hypogastric glands.

The *absorbents* accompanying the *ischiatic, gluteal,* and *internal pudic arterial rami*—correspond so completely

with the distribution of those vessels, as to require no separate description. They all terminate in the hypogastric glands.

The *deep absorbents of the testes*—arise from the substance of the epididymes and testes, pass upward in the course of the spermatic cord, and are from eight to ten in number. They continue from the internal ring, with the spermatic arteries, and terminate in the lumbar glands.

*Small absorbents,* from the *prostate gland, and vesiculæ seminales*—also terminate in the hypogastric glands.

The *absorbents of the uterus*—are large in size during the period of gestation, but at other times, are with difficulty demonstrated. They arise in two sets, one from the surface, and the other from the substance of the organ; the former unite with those from the vagina, and with the latter, terminate partly in the hypogastric, and partly in the lumbar glands.

The *ilio lumbar absorbents*—take their course with the distribution of the corresponding arterial rami, and unite to form larger absorbents, which pass under the psoas muscle, to terminate partly in the inferior lumbar, and partly in the glands which surround the external iliac artery.

*Sacral absorbents*—arise from the cellular membrane surrounding the rectum, sacral nerves, and pyriformis muscle; some of them pass out of the anterior sacral foramina, and all finally enter into the formation of the hypogastric plexus, surrounding the blood-vessels of the pelvis; and terminate in the inferior lumbar, and hypogastric glands; anastomosing with the lumbar absorbents above, and the external iliac absorbents below.

*Epigastric absorbents*—arise from the anterior and middle parietes of the abdomen, anastomosing freely with the absorbent vessels from the abdominal muscles, and from trunks which take the course of the ramus epigastricus, and terminate in the external iliac glands.

The *absorbents of the circumflexus ilii*—take their course

with their corresponding ramus, and in like manner terminate in the external iliac glands.

The *lumbar absorbents*—arise from the m. quadratus lumborum, and transversus obliquus, and the interior of the vertebral canal. They form numerous trunks, which take the course of the lumbar arteries, and pass between the psoæ, and quadratus lumborum muscles, to terminate in the glands between the transverse processes of the vertebræ. Some pass forward upon the vertebral column, and freely anastomosing, contribute to form the lumbar plexus.

## Absorbent Vessels of the Viscera, contained within the Cavity of the Abdomen.

Those belonging to the generative organs, have already been mentioned: the remaining appertain to the urinary organs, and the chylopoetic viscera.

### Absorbents of the Urinary Organs.

*Absorbent vessels of the bladder.*—These arise from the whole surface of the organ, forming a considerable plexus on its parietes, and terminate in the hypogastric glands.

*Absorbents of the kidneys, and ureters.*—These arise superficially from the external surface of the kidneys, and are directed toward the sinus, where they are forming trunks, which unite with the deep-seated absorbents of the interior of the organ. The two sets then terminate in the lumbar glands. From the ureters, the absorbents take the course of those of the bladder and kidneys, terminating partly in the lumbar glands, and partly in the hypogastric.

*Absorbents of the capsulæ renales*—arise within the substance of the organ, and passing out with the blood-vessels, anastomose with the absorbents of the kidneys; some on the right side, terminating in the hepatic glands, and on the left, with the splenic, on the corresponding pillar of the diaphragm.

*Absorbents of the Chylopoetic Viscera—of the Liver—*
*Stomach and Intestines.*

These are usually called lacteals. The greater portion of them arise from the inner surface of the intestines by open mouths in the villi.

They are most abundant in the small intestines; and collecting, form innumerable branches, which enter the mesenteric and meso-colic glands; ultimately terminating in the large trunk, named the thoracic duct.

*From the stomach*—the absorbents arise in two sets, one superficial, the other deep. Of the first, several arise from the great curvature, and follow the course of the vasa brevia, anastomosing with the absorbents of the spleen: others pass off from the small curvature, to the neighbouring glands, and then continue, some to anastomose with the hepatic glands, near the lobulus spigelii; while others pass to the posterior part of the pancreas, terminating in the thoracic duct.

From the upper and lower surfaces of the stomach, absorbents arise, which pass to the glands of the great curvature, after forming large trunks near the pylorus, and accompanying the coeliac, and superior mesenteric arteries.

*Absorbents of the liver*—are both superficial, and deep.

The superficial are divided into separate sets — generally four or five in number. One of these from the middle, both of the right and left lobe, forms several large trunks, which ascend between the layers of the suspensory ligament; then pass behind the ensiform cartilage, uniting with the glands there situated; and continue, finally terminating in the thoracic duct, close to the left internal jugular vein.

A second set arise from the right lobe, pass to the right lateral ligament, through the diaphragm, continuing upon its convex surface, until they terminate in the first set.

A third set arise from the left lobe, pass to the left lateral ligament, anastomosing with the absorbents of the stomach,

and then terminate in the thoracic duct before it has quitted the abdomen.

The superficial absorbents of the under surface of the liver, form two principal sets, which after uniting, form one set, freely anastomosing with those of the upper surface, and with the deep-seated absorbents: they then unite in trunks, which collect at the porta, and take the course of the hepatic vessels, freely anastomosing with the ·absorbents of the intestines.

The deep-seated absorbents of the liver, arise in the substance of the gland, and take the course of the minuter ramifications of the blood-vessels, then that of the main trunks, passing out with them at the porta; here they join the absorbents of the inferior surface of the liver, and anastomose with those of the stomach, spleen, pancreas, and mesentery—finally terminating with them, in the thoracic duct.

The absorbents of the omenta, collect with the superficial absorbents of the stomach, and pass to terminate in the glands at its greater curvature.

*Absorbents of the spleen*—arise from the organ, both on its surface and within its substance, forming trunks, which anastomose with those of the pancreas, and the inferior surface of the liver.

*Absorbents of the pancreas*—arise from the organ in a similar manner, terminating with the absorbents of the spleen and stomach.

*Of the left thoracic duct.*—This is the principal terminating trunk of the absorbent system; it commences in the abdomen, upon the body of the third lumbar vertebra, behind the right emulgent artery; and extends to the junction of the left subclavian, with the left internal jugular vein, where it terminates by opening into the posterior part of the left vena innominata, formed by this union. At its termination, it is furnished with valves, to prevent the regurgitation of the chyle from the vein.

The commencement of the thoracic duct is formed of

three or four large trunks, which proceed from the absorbents of the lower extremities, and which by their union, produce so great an enlargement, as to have been named the receptaculum chyli—but improperly ; for this sac only receives the product of the absorbents, from the lower extremities, and not from the lacteals. The lacteals open into the thoracic duct, above this point, to the right of the second lumbar vertebra, at the united roots of the mesentery and meso-colon, where the duct is narrow, and does not present any appearance of a reservoir ; from this point, it ascends from the abdomen into the chest, passing between the right crus of the diaphragm and the aorta, being accompanied by a branch of the vena azygos, which is on its right. It continues on the right side of the aorta, as high as the junction of the fifth and sixth dorsal vertebræ, when it ascends to the left, behind the œsophagus and the arch of the aorta, in front of the longus colli muscle, on the inner side of the left subclavian artery, passing through the upper opening of the chest, as high as the upper part of the seventh cervical vertebra. It then bends downwards and inwards, passing in front of the ramus thyroideus inferior, behind the left internal jugular vein, terminating, as has been before described, at the angle formed by the union of that vein with the left subclavian. In this course, the thoracic duct is not every where of the same size. We have already mentioned the enlargement, at its commencement ; after which it contracts, remaining of the same calibre as high as the sixth dorsal vertebra ; and while passing behind the arch of the aorta, it is again enlarged. This duct is also variable in its direction, being more or less tortuous in different subjects, as well as in its division into separate branches ; which either again unite, or terminate separately on the left side, or one in the left, and the other in the right thoracic duct.

The *right thoracic duct*—is much smaller than the left, receiving only the absorbents of the right side of the upper part of the body. It is seldom more than half an inch in

length, and is sometimes wanting; in which case, the absorbent vessels, without forming any duct, terminate separately, either in the right vena innominata, or subclavian vein.

For the practical remarks connected with the absorbent system, *vide* Vol. III. p. 298.

# LECTURES ON ANATOMY.

## PART VIII.

### PHYSIOLOGY OF THE NERVOUS SYSTEM, &c.

# LECTURE XXX.

THERE is no part of the anatomy and physiology of the
human body, which has occupied more attention and diligent
investigation, than the nervous system. As the peculiar seat
of the intellect, it may be regarded as the most noble part
of our frame, and that which appears to be most essentially
connected with all the peculiar phenomena of vitality.

Notwithstanding the most learned men, in all ages, have
devoted their attention to the nervous system, in order to
trace the connection between vital phenomena and material
bodies, exhibited in the form of living beings; the subject
is still veiled in obscurity, and remains a work of creative
wisdom, far above human comprehension.

We are, however, indebted to the labors of modern
anatomists for many new and important facts relative to the
functions of the brain and nerves; and these may be con-
sidered in the order of their developement, their structure,
and their general distribution, from which arise the various
combinations exhibited in their functions.

The nervous system comprehends the brain, medulla
oblongata, medulla spinalis, the cerebral, and the sympa-
thetic nerves.

It was formerly considered, that the brain was the origin
of all the nerves; but of late years, the anatomy of the
brain has been more particularly investigated in all the
stages of its early developement, as well as in relation to
the separate influence which individual parts exert over
particular functions.

Tiedemann, in pointing out the order of the succession in which the different parts are developed during its fœtal growth, has shewn that there is a remarkable relation between the state of the human brain in its earliest existence, and that of the permanent structures of the lower order of animals. At first, as in them, it is simple, and possesses but few parts, which become more numerous and complicated as the organ proceeds to its full developement; and having these various parts superadded to it, much in the order in which they are found in the progressive scale of animal perfection.

To M. Serres, we are indebted for the light which he has thrown upon the cause, which immediately regulates the growth of the whole nervous system; and this he has found to depend upon the distribution of the arteries. Thus he has observed, that the spinal marrow is produced by the intercostal arteries, which are the first formed blood-vessels in the fœtus; the cerebellum, by the vertebral; and the cerebrum, by the carotid arteries. In these formations, the crura cerebri and tubercula quadrigemina, follow that of the spinal marrow; the cervical region of which is first formed, by the branch of the superior intercostal artery, which enters the vertebral canal. The vertebral artery arrives the last within the cranium, and the cerebellum is therefore the last organ apparent in the formation of the encephalic organ of all classes. Following the arterial order of nervous developement, it is observed that the cerebellum is formed from behind forwards, and the cerebrum, on the contrary, from before backwards; according, in the first instance, with the vertebral artery, which enters at the posterior part, and is directed from behind forwards; and in the latter instance, with the internal carotid artery, which after passing the turns of the cavernous sinus, reaches the anterior part of the brain, and proceeds from before backwards, according to the progress of the formation of the cerebrum.

Hence also the corpus callosum, and anterior part of the fornix, are developed from before backwards, following the

progress of the artery; while the posterior part proceeds from behind forwards, with the posterior cerebral artery.

In animals, the developement of the cerebrum and cerebellum, results from the general relation in this union of the vertebral and carotid arteries; and the comparative size of the brain and spinal marrow, appear to depend upon the respective calibre of the arteries which supply these parts with blood. Thus when the spinal arteries are large, the more the spinal marrow is developed; and the more the vertebral and internal carotids increase in size, the greater is the developement of the brain. And it is remarkable, that these structures bear an inverse ratio in their formation, which does not depend upon the preponderance of any portion of the nervous matter in the spinal marrow, but entirely upon that law of life which has regulated the distribution and course of the sanguineous system.

This, as a general principle, is applicable to the nerves in all parts of the organismus.

Thus the great sympathetic nerve diminishes in proportion to the decrease of the sanguineous system.

The size of the middle sacral artery, regulates the dimensions of the caudal prolongation in all animals.

The appearance of the extremities, and their nerves, also depend upon the calibre of their respective arteries: thus the axillary arteries in bimana, and the femoral in bipeds, are those which attain the fullest developement. So in the head, the developement of the face and the brain depend on the volume of the external carotid in the former, and of the internal carotid in the latter. Where the external carotid is large, the face and nerves of sense are extensive.

The ophthalmic artery, however, is always in proportion to the size of the external carotid; from which circumstance, the volume of the eye is still regulated according to the extent of the organs of smell and taste.

Tracing the formation of the nerves themselves, their first appearance is in the form of globules of medullary matter, deposited in the cellular and mucous tissues; these increase,

and unite in centres of communication, which form the
ganglia: from the ganglia, cords communicating with
each other, are next seen taking the course of the larger
blood-vessels. This organized state, is first apparent in the
semilunar ganglion; and after the ganglia, then the centres
of communication of the voluntary nerves appear; and lastly,
the nerves destined for the higher powers of voluntary
motion and sensation.

According to Dr. Bennett, who adopted the method re-
commended by Riel, of hardening the embryo in spirits, the
brain and spinal marrow are perceptible as early as the
seventh week, enclosed in a dura and pia mater—the medulla
oblongata being twice as thick as the medulla spinalis.

At this period, he describes the spinal marrow as ex-
tending nearly along the whole trunk, and having a fissure
at its posterior part, into which the pia mater penetrates;
and beneath this fissure, is a cavity or internal canal, ex-
tending along the spinal marrow, from the sacrum to the
fourth ventricle.

. At the superior part of the column, just before its en-
trance, within the cranium, an enlargement or projection
is perceptible, where the fourth ventricle takes its origin;
beneath this projection the spinal marrow forms a curve,
owing to the flexion of the head upon the chest; and on
either side, there is a thin narrow plate inclining from
without inwards, forming an arch over the fourth ventricle;
these are in contact with, but not united to each other, and
afterwards constitute the cerebellum, springing from the
restiform bodies. Beyond these appear rudiments of the
crura cerebri and tubercula quadrigemina, with the aqueduct
of Sylvius between them; more anteriorly lying on the crura
cerebri the optic chambers appear, with an interval between
them corresponding to the third ventricle. In front of the
rounded extremities of the crura cerebri, the corpora striata
appear; and lastly, two membranous plates curving in-
wards and backwards, forming the commencement of the
hemispheres of the cerebrum. At this early period, the

commissures, pons varolii, corpus callosum, fornix, or its
crura, are not perceptible.

The spinal column unites its cavity with the fourth ven-
tricle, at the calamus scriptorius, which at this period may
be said to be merely a dilatation of the canal. In fact, the
canal forms a broad fissure, which comprehends the third
ventricle, aqueductus Sylvii, fourth ventricle, and calamus
scriptorius; and is uninterruptedly continuous in the whole
length of the spinal column. Towards the end of the se-
cond month, the pia mater is observed dipping into the
anterior and posterior portion of the column—the latter
constituting the canal of this organ. This canal, at first
capacious, appears to lessen in proportion to the deposit of
medullary matter. The medullary matter is white, until the
last two months of utero-gestation, when it becomes soft and
reddish, constituting the cortical substance; which circum-
stance refutes the hypothesis of Doctors Gall and Spurzheim,
who consider the medullary matter as formed from the
cortical.

A gradual process of developement continues, of which an
elaborate account has been given by Dr. Bennett; *vide*
Plate 1.; from which it appears, that the following
parts succeed each other in their growth. The olivary and
pyramidal cords project upwards; the cerebellum forms
over the fourth ventricle, by the union of two plates, one
from either side, when the canal ceases to be open. The
mass which supports the tubercula quadrigemina, arises by
two small thin membranes from the olivary tubercles; these,
as they enlarge, first cover a large ventricle, which after-
wards becomes the fissura Sylvii, from a further deposit of
medullary matter. The pyramidal cords taking a direction
from below upwards, and from behind forwards, first form
two swellings, which are the optic thalami, and corpora
striata; and then terminate in two lamina, which bend from
before backwards. These are the rudiments of the two hemi-
spheres of the cerebrum: at the second month, these laminæ
scarcely cover the corpora striata; at the third month, the

optic thalami; at the fourth, the tubercula quadrigemina; and at the sixth and seventh, the cerebellum. In this progress of formation from before backwards, their inversion gives rise to the lateral ventricles. The parietes of the hemispheres are yet smooth; and the appearance of convolutions does not arise until the eighth and ninth months, when the accession of medullary matter is more rapid, and of a darker color, constituting the cortical substance, and lastly the convolutions appear.

Having now considered the order of the fœtal developement of the nervous system, we will next proceed to the intimate structure of the nerves.

A nerve is composed of numerous white filaments, united together in bundles by cellular membrane, and enclosed in a thicker sheath termed the neurilema. It is supposed, that each nervous filament is composed of a tube of pia mater from the brain and spinal marrow; and that it encloses a medullary pulp, capable of concretion by means of nitric acid.

Numerous arteries and veins ramify in the neurilema, and are easily seen in the larger nerves. It is also supposed, that each nervous filament has an origin in the brain, or spinal marrow, and a termination in the part to which it is distributed.

As far as the nerves are visible, they form numerous unions, divisions, and re-unions with each other; from which it is neither possible to trace a single filament, or to ascertain the exact nature of their minutest structures.

They appear to unite and separate, but not to run into one another, in the same manner as the vessels of the sanguineous system.

Four kinds of nerves have been enumerated.

1. Nerves with double roots, the one a conductor of sensibility, the other of motion; these are all the spinal, the sub-occipital, and the trigeminal, or fifth pair.

2. Nerves with a single origin, to the senses and muscles connected with them.

3. The respiratory nerves.

4. The sympathetic, which unite with all the spinal; and probably with all the cerebral nerves.

In the first and second classes, sensation and motion have distinct agents; in the third and fourth, their functions are associated, more or less, by intimate connections.

To the optic nerve, a membranous sheath is furnished directly from the dura mater, and an artery runs in its centre. Nerves in osseous canals also have no membranous sheath, as the vidian branch of the fifth; and they are of greater consistence than nerves enclosed in soft parts.

Having premised these circumstances of the fœtal developement of the nerves, and their structure, we shall be better enabled to trace the mutual dependance, and variety of their functions.

The distribution of the sympathetic nerves, is found to exist in all animals; and as we ascend the scale of perfection exhibited in different orders, we find a gradual succession, first of more numerous ganglia, then of sentient and voluntary nerves, and lastly of an increased bulk of brain which characterizes the mental faculties.

The most limited distribution of nerve, is met with in the form of globules, which are disseminated without apparent order in the substance of the amorphous pulpy mass, of the lowest order of zoophytes. These globules are next met with, confined to the mucous structures only; then organized in an imperfectly developed, but homogeneous ganglion, as in the echinodermata: next, these ganglia communicate by intermediate cords, as in the annelides, &c. The ganglia are then found to lose their homogeneous character; and separate organs appear devoted to the senses, with accessory ganglia, assuming the character of an encephalon, surrounding the œsophagus in the manner of a ring. In these animals, distinct volition is not apparent, but rather a species of instinct, independent of reflection or choice, and presiding simply over the functions of nutrition, and immediate preservation. Next we find the senses and volition more distinct, the appearance of a spinal column,

and the encephalic ganglion losing its simple character, and
becoming enclosed in a protecting case; at the same time,
the spinal marrow appears also enclosed in a protecting
apparatus.

In the hymenopteræ, each sensorial nerve has a distinct
enlargement at its root in the encephalon; and the division
into hemispheres begins to be apparent, forming the pro-
totype of the cerebral masses or hemispheres of all the
superior classes.

This order of existence in different animals, has been com-
pared to the progressive developement of the nervous system
in man, and the appearance of the growth of the fœtal brain
and spinal marrow.

In man, the nerves arise from the brain, medulla ob-
longata, and the medulla spinalis, and are distributed to
the different parts of the body, for the purpose of convey-
ing their vital and sensitive powers—termed also their
influence. It was formerly considered, that every nerve
conveyed each kind of influence; but we are indebted to
Sir Charles Bell, for new views, and a more correct know-
ledge upon this subject. He first discovered, that certain
nerves conveyed the powers of motion; and that others were
destined for the purposes of sensation; while a third set
conveyed influences, which regulated the functions of respi-
ration—and these he termed respiratory nerves.

It is a wonderful provision of nature, that a bundle of
nerves, united by cellular membrane into one cord, should
be capable of containing filaments gifted with such oppo-
site powers, as those of motion and sensation; while, upon
the minutest anatomical inspection, these filaments do not
offer the slightest difference in their appearance.

The only difference which has been traced in nerves, is in
their origin, or roots; these roots are embedded in the brain,
medulla oblongata, medulla spinalis, or the ganglia; and
in these situations, the difference amounts to little more
than a slight variation of color. Thus it has been found,
that nerves of motion proceed from the anterior, and

nerves of sensation from the posterior pillars of the spinal
column; while nerves which are distributed to parts con-
cerned in respiration, proceed from the sides of the column.
Before the nerves of sensation unite to form a common
cord with the nerves of motion, they produce a ganglionic
enlargement; and are observed to come out from the co-
lumn, more abruptly, in more regular filaments, and from
a smaller surface than the anterior filaments, or nerves of
motion.

From these circumstances Sir Charles Bell has concluded,
that every nerve is composed of numerous filaments, each of
which has an origin from one of the above-named sources,
called its root; and that it is continued, although bound up in
cellular membrane and forming a common cord, to the place
of its ultimate distribution, independent of the other filaments,
and conveys a distinct influence. Hence it is, that when the
posterior fasciculi of a spinal nerve are divided, the parts to
which it is distributed are found to lose their sensation—
their power of motion remaining unaltered; while if the
anterior roots are divided, paralysis follows—but sensation
still remains.

So far the distribution of nervous influence is simple, and
easy to be traced; but the anatomist will find a greater
complication when he comes to trace a spinal nerve to its
destination; it is impossible for him to unravel a single
filament, or even to trace the course of a filament of a
motor nerve, from the root to the part that it is destined to
move. This complexity arises from the numerous inter-
changes and inosculations of the branches, forming what is
termed a plexus.

These are more numerous, and to a greater extent, in
proportion to the number of muscles, and the variety of their
functions. Thus the nerves of the face and neck, and the
commencement of the upper and lower extremities, are
instances of such distributions.

It is not improbable, as suggested by Sir C. Bell, that
these numerous interchanges of filaments have much to do

with the curious combinations of action among antagonist muscles; as for instance, in the arrangement between extensors and flexors, and contraction and relaxation.

As yet our knowledge does not enable us to form any idea of the means by which the nerves are capable of producing their influence; and hence it is, that various hypotheses have arisen, assigning it to an undulating fluid, to vibration, a nervous atmosphere by which it was capable of extending its influence beyond its termination, to electricity, and to galvanism. All that we know however, is, that there is a connection through the medium of the nerves, between the brain and the muscles, which enables us at will to excite our voluntary muscles to motion; this is therefore a voluntary power, and is lost immediately upon the division of the nerve. This proves that the influence of the will, proceeds from within to without; but with respect to the sentient nerves; from which we derive the faculties of touch, sight, hearing, smelling, and taste; it is their ultimate distributions which receive the impressions, and convey them from without to within, or from the surface to the sensorium. It has been supposed by some physiologists, that as far as refers to the nerves of the senses, it is necessary that the influence should be conveyed to the brain, so that each peculiar sensation may have a large mass of nervous matter for its perception; from which it has been concluded, that the brain is the great centre of intellect, although the integrity of the spinal marrow is essential to the due influence of the brain, and they have a mutual dependance on each other, presiding over the whole organismus.

Having thus generally described the nerves of motion, sensation, and respiration, we will revert to the consideration of the sympathetic system of nerves.

The great distinction between the sympathetic and other nerves, is, that the former preside over involuntary living functions, such as growth, and nutrition; while the latter preside over the voluntary and sentient functions, as motion, and the organs of the senses.

Hence it will readily be seen, why the ganglionic nerves are required only in the lowest animals, possessing simple organic existence ; and why the higher animals, endowed with additional powers, are furnished with nerves in proportion to the addition of living functions. :

The following table presents some of the leading features, which distinguish the sympathetic from the cerebro-spinal nerves.

| SYMPATHETIC NERVES. | CEREBRAL. |
|---|---|
| *Termed 'also Ganglial, Organic, and Vital Nerves.* | *Named also Cerebro-spinal, Voluntary, and Sentient Nerves.* |
| Found in every order of the animal creation. | Found only in the highest order of the animal creation. |
| Traced from the earliest development of the fœtal organisation, and never deficient in monstrous births. | Developed subsequently to the ganglionic nerves, and occasionally wanting in monstrous births. |
| Excited by galvanism with difficulty. | Excited by galvanism readily. |
| Distributed particularly to the organs of digestion, assimilation, circulation, and secretion ; and involuntary muscles — occasionally to voluntary muscles. | Distributed particularly to the organs of the senses, and voluntary muscles—occasionally to involuntary muscles. |
| The arteries receive ganglial nerves. | Are not distributed to the arteries. |
| Arise from one or more ganglia, in the interior of the body, as from a centre. | Arise from the brain, and spinal marrow. |
| Is more independent, the younger and the lower the animal is in the scale of creation. | A mutual dependance of function becomes more intimate, with ganglial nerves, as we ascend the scale of creation. |

The sympathetic nerves not only perform all their functions with unerring precision, and carry on the processes of life, independent of either voluntary or sentient nerves; but they are also connected with those nerves, so as to combine

with them in many functions, and act independently of them in others. Thus, for instance, growth, nutrition, circulation, and regeneration, are wholly vital functions, and depend upon the ganglionic nerves for their influence. These functions, however, are not only essential to the existence of the animal, independent of each other, but they also have a combined-action for higher functional powers; thus, circulation is not only necessary for the existence of the animal, but it is also inseparably connected with the process of respiration; and respiration itself is not only essential to existence, and more or less subservient to circulation, but is further intimately connected with the intellectual faculties of man, as forming the chief instrument of voice and speech: —which functions, being carried on by muscular power, shews the necessity of the union of these nerves with those of motion; and as motion here must also be under the influence of the will, there is a combination of all the nervous influences, through the medium of the sympathetic system.

Thus then we have the sympathetic system of nerves, existing in every animal which has life. Next the encephalic, connected to the ganglionic; becoming more in the character of a brain, as the animal has organs of sense and loco-motion; while the sympathetic, at the same time, is connected by nervous cords, which assumes the appearance of a spinal marrow, as locomotion becomes distinct from the process of digestion and nutrition: but in all, even the more perfect animals, the sympathetic nerves are the first formed, and may be traced in embryos before the spinal marrow or brain are perceived.

In their distribution, and mode of ramification, they differ from the cerebral nerves, and supply separate organs and textures. In their origin, they are traced from the tissues and cellular textures of the earliest formations, and unite with the spinal column—from which latter the brain proceeds; therefore it has been an error to suppose that the nerves are formed from the brain, and spinal column.

A connection so intimate and general takes place in the combinations of the functions of the whole nervous system, that, indeed, they descend by imperceptible degrees, until they are not distinguishable from other living functions, as circulation, respiration, &c.

This connection takes place, principally, in the medulla oblongata; and as the spinal column consists of different component pillars or cords, so is its termination separate—the posterior pillars passing to the cerebellum, the anterior to the cerebrum; and by some physiologists it has been supposed, that the corpora quadrigemina form a centre of influence to the ganglionic nerves; by others, the ganglionic have been considered as a mere collection of branches, formed by filaments reciprocally given off and received from all the rest of the system.

Physiologists have pursued the research, in order to discover the particular connection and influence of the nervous system over the muscular, and other vital powers.

Several curious facts have been the result; which prove still further, how intimately the whole nervous system is connected. Thus it has been found, that although particular nerves are distributed from the spinal column to the various muscles and skin, imparting sentient and voluntary influences; yet there are certain powers connected with the brain, which preside over the direction of these muscular actions.

This has led to a series of experiments, which consisted of slicing off portions of the brain in a living animal, and marking the effects produced. Some of these are extremely curious.

In mammalia—the hemispheres of the cerebrum may be cut away, down to the corpora striata, without exciting any sensible effect of pain; but the senses of hearing and sight are lost; and the will no longer manifests itself by voluntary acts. The animal appears to act, and to perform regular movements, as if the memory was lost, with its seat the hemispheres.

N

Thus the integrity of the cerebrum appears to be necessary, to the senses of hearing, seeing, memory and volition.

Upon removing the cerebellum, the locomotive powers are deranged; and its integrity appears to be necessary for the powers and regularity of locomotion.

Majendie states these effects in the following order.

The removal of the hemisphere of the cerebrum in birds, leaving the optic tubercles untouched, produces a lethargy; but, in numerous instances, they will run, jump, and swim—sight only being extinct.

In reptiles and fishes, no effect is produced.

On removing the corpora striata in mammalia, the animal darts forward with great rapidity; if it stops, it preserves its attitudes of escape.

On removing the cerebellum, the power of motion ceases, in proportion to the quantity removed, until it stops altogether. On injuring this part, the animal attempts to move backwards only. Hence it appears that there are two powers in equilibrium—one inducing forward, the other receding motions; and when either of these are destroyed, the other predominates with an irresistible propensity—uninfluenced by the will.

There also appears to be similar powers presiding over the lateral and rotatory motions of the body.

If one of the crura be divided, the animal immediately begins to roll about, as if irresistibly impelled, to the side on which the crus is divided; so rapid, as to make sometimes sixty revolutions in a minute—the same occurs to each crus; and the motions are more rapid the nearer the division is made to the origin of the crura, or near to the pons Varolii.

On tracing these effects in an opposite direction, it was found, that there was a point beyond which irritability of muscular powers ceased—this point is the corpora quadrigemina; from whence it has been concluded, that the cerebrum and cerebellum are not irritable, and wounds

of these parts do not excite or cause convulsions; but at the commencement of the tubercula quadrigemina, the medulla oblongata originates, and with it, sensation.

In a voluntary muscular action, three causes appear to operate—for the will only excites and determines the movement, but is not the efficient cause; the spinal marrow and nerves are the immediate cause.

1st.—Volition of movement, residing in the cerebral hemispheres.

2nd.—Regulation of movement, residing in the cerebellum.

3rd.—Excitation of the above movements, in the spinal marrow and nerves.

The one excites, the next regulates, and the other receives.

Thus sight may be destroyed in two ways—by the removal of the tubercula quadrigemina, causing the loss of the sense of sight; or the removal of the cerebral lobes, causing the loss of the sensation of sight.

There is, therefore, distinct organs for the senses, for the sensations, and for the movements.

From the above considerations, we are naturally led to the intricate subject of the mind, as the result of the complete and healthy performance of all the nervous and vital functions of the body.

This, like many of the vital phenomena, may be said to be known only by its effects; its cause has baffled the researches of the most learned in all ages, and remains to this hour unknown.

I must, however, advert to the researches of Gall and Spurzheim, which appear to have arisen in the observation, that the volume of the hemispheres is in proportion to the degree of intellect possessed by the animal.

The length to which they have carried their observations, however, in assigning particular convolutions or portions of the surface of the brain to every passion and propensity, extending even to the predilection for particular arts and sciences, and of arranging them as so many distinct organs, requires far greater proofs for their establishment than we

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at present possess; for it may be observed, that we so fre-
quently meet with the external table of the skull having
elevations without corresponding depressions of the internal
table; and again, enlargements of the convolutions, pro-
ducing depressions of the internal table, yet no corresponding
elevation of the external table—that inferences so -general
and decided as those assumed by Gall and Spurzheim,
appear to be too fallacious to be relied upon. Great credit
is however due to them, in an anatomical point of view, for
the method in which they traced the fibres of the medullary
matter of the brain; and which has certainly led to im-
portant facts, relative to its intimate structure.

I shall not here enter into a detailed account of the mode
by which Gall and Spurzheim trace the columns of the
spinal marrow into the substance of the brain, to enter into
the composition of its several parts; but in the descriptive
anatomy of these parts, I shall speak of their connection
with the spinal marrow.

Dr. Foville, of Rouen, has also added some important
facts to our knowledge, respecting the anatomy of the brain,
and has supported his doctrines by numerous pathological
facts.

In a demonstration which he gave at Guy's Hospital, in
1830, he stated, that he considered the corpus callosum was
not produced by the transverse fibres of the hemispheres
running across from one side to the other, forming a com-
plete commissure, as stated by Gall and Spurzheim; but
that it is produced by the corpora pyramidalia, after they
have entered the corpora striata, rising up and forming a
union in the middle line above the striated bodies and tha-
lami—thus forming the corpus callosum; while another
portion passing downwards and inwards, and then upwards
to the middle line of the corpus callosum, where being only
slightly separated from a similar structure or plane of medul-
lary matter in the opposite side, produces the septum
lucidum and fifth ventricle; while a third portion, passing
laterally, goes to the hemispheres of the brain. To explain

this better, it will be necessary to trace Dr. Foville's view from the spinal marrow; which is composed of two symmetrical portions, each formed of an anterior, posterior, and middle column.

The portion of the spinal marrow named the medulla oblongata, forms several enlargements; one part of which is prolonged into the cerebrum, another into the corpora quadrigemina, and a third into the cerebellum.

Thus the corpora restiformia, are traced to the cerebellum; the corpora olivaria, to the tubercula quadrigemina; and the corpora pyramidalia, to the cerebrum: the anterior fibres of the corpora pyramidalia decussating.

In the cerebellum, the corpus restiforme unites with the processus ad testes and the tuber annulare, forming a mass, which expands into a plane extending from within outwards, to the cineritious matter, where it lines all the folds formed in the cineritious exterior.

One part of this plane passes backwards, from without inwards; and with its fellow from the opposite side, forms a commissure in the processus vermiformis, analogous to the corpus callosum, or commissure of the cerebrum.

The corpora olivaria, form two bundles of fibres, which may be traced to the tubercula quadrigemina.

The corpora pyramidalia, each forms two bundles of fibres —the anterior of which only decussate; the posterior continue to the superior transverse fibres of the tuber annulare, and rest upon it, while their upper surface forms the floor of the fourth ventricle. These two bundles are separated from each other by the corpus niger, and proceed nearly parallel till they diverge in the corpora striata, and thalami nervorum opticorum; and form a large plane, directed obliquely outwards and upwards, of nearly a triangular figure, bounded by two straight and one curved line. The two sides of the expanded crus, or plane, form the two straight lines; the corpus-striatum and thalamus, the curved line to the outer side of the ventricle—to which the expanded fibres diverge as to a circumference.

From this circumference three separate planes proceed, forming three layers, one above the other, at their origin.

The first or superior of these planes, rises on the outer side of the corpus striatum and thalamus, at first nearly vertically; it forms a slight convexity outwards, and then bending inwards horizontally towards the mesian line, unites with its fellow to form the corpus callosum.

The corpus callosum, therefore, proceeds from the crura cerebri, and has nothing to do with the hemispheres; they form a true commissure to the crura cerebri; but Dr. Foville observes, that he has not ascertained whether the fibres of the two sides cross or anastomose with each other.

The second plane or central one, immediately beneath the former, at first ascends parallel with, and applied to that of the corpus callosum; then it separates, and is reflected inwards, nearly in a vertical direction, until it reaches the cineritious substance of the most elevated part of the hemispheres, along its whole length, when the convex external and flat internal parts meet each other. It lines the grey matter, following all its folds in the form of a white layer, of which the fibrous structure is not so evident as that of the plane itself. The fibres of this layer, therefore, diverge towards the circumference, and converge towards the expansion of the crura, of which they are a continuation.

The third plane, is of less extent than the two preceding; it proceeds from the same line with them, and descends to the outer side of the inferior half of the grey substance of the corpus striatum, invests it below, and advancing inwards, meets the corresponding plane from the opposite side, and then ascends, forming the septum lucidum of the ventricles. Some of the fibres of this plane do not pass directly to the septum lucidum, but pass backward, reach the extremity of the cornu ammmonis, and becoming continuous with the corpus fimbriatum, pass into the fornix, and form a second communication with the septum lucidum. Other fibres pass and form an expansion, especially destined for the temporal lobe of the hemispheres.

From these interesting anatomical points, Dr. Foville considers that the cerebellum is the central organ of sensation; the tubercula quadrigemina, of the influence of organic life; and the cerebrum, of motion; and that the mind resides more particularly in the cineritious matter, as a percipient centre: and considers the medullary part of the brain as the nerves, conveying the influence of the will from the sensorium to the exterior of the body, or parts of motion, and conveying to the sensorium the impressions of the exterior senses.

As physician to a large lunatic asylum at Rouen, Dr. Foville had an opportunity of examining frequently the brains of those who were the subjects of different kinds of madness; from which he was led to divide mental derangements into three classes. Those depending on false impressions, in which the medullary portions were found diseased, and hence their powers of conducting proper impressions deranged; those depending on a troubled state of mind itself, in which the cineritious portions were diseased; and in those depending upon paralysis of the insane, he found the cellular membrane connecting the fibres of the medullary part of the brain so altered by inflammation, that its structure could not be unravelled.

When extravasation of blood has occurred into the brain, Dr. Foville has seen paralysis recede as the blood became absorbed, and recur at intervals if the disease tended to farther extravasation, either of blood or serum. He also brought forward several cases, to prove that the motions of the lower extremities depended on the integrity of the thalami, and of the upper extremities on the integrity of the corpora striata; and one case in particular, where a surgeon, on putting on a ligature around the axillary artery, included some or one of the axillary nerves; the result of which was an abscess in the thalamus, and consequent death. In diseases extending from the corpora striata to the thalami, the lower extremities are first affected, and then the upper.

In the annexed diagrams, the developement of the structure of the brain, according to Dr. Foville, will be seen, and should be compared with the dissections and plates made by Gall and Spurzheim; the former may perhaps be considered preferable, inasmuch, as it is supported by pathological facts of so much importance to medical science.

# LECTURE XXXI.

## The Membranes of the Brain.

THE brain and spinal marrow, are invested with three membranes—the dura mater, tunica arachnoidea, and pia mater.

The *dura mater*—is the external of the three envelopes; it is composed of two laminæ, the external of which lines the inner surface of the bones of the skull, and its vessels unite with the external pericranium—this may be termed its periosteal portion; while the inner is destined to support and insulate different parts of the brain, and may be considered as its cerebral lamina.

The *periosteal, or outer lamina*—belongs to the fibrous tissue; it is in close apposition with the bones of the skull, to which it is firmly united, more particularly in the course of the sutures, so as to render it difficult to remove the calvarium. When this has been done, the dura mater presents an uneven flocular appearance, from the filaments and blood-vessels being torn through, which had connected this membrane to the bones.

At the base of the skull, the periosteal portion of the dura mater is much more firmly united than on the vertex, in consequence of the numerous inequalities of the surface; and also from its sending prolongations through the various foramina, for the purpose of defending the nerves which they transmit. It is likewise continued along the whole length of the spinal column, to give a covering to the spinal marrow. Some anatomists have given a minute description

of the attachments of the periosteal surface of the dura mater, over each bone entering into the formation of the skull, pointing out the situations in which it is more or less firmly attached; but as these attachments invariably depend upon the irregularity of the surface, the foramina, or the junction of the bones, osteology points out sufficiently where they must necessarily occur.

Upon the external surface of the dura mater, in the course of the sagittal suture, a number of small projections may be observed, which usually produce corresponding depressions upon the parietal bones—these are termed the glandulæ Pacchioniæ; their use is entirely unknown. The organization of the periosteal surface of the dura mater, is similar to the rest of the fibrous system, being composed of numerous fibres of a metallic lustre, running in parallel lines, and connected with each other by cross fibres.

The *internal or cerebral lamina* of the dura mater—presents a smooth, moist, polished appearance, which it acquires from the secreting surface of the tunica arachnoides. Although described distinct from the external coat, it is with great difficulty separated, excepting in the course of the sinuses, and the commencement of its different septa and processes.

The processes formed by the internal layer of the dura mater, are the falx major, vel fulx cerebri,—falx minor, vel falx cerebelli,—and the tentorium.

The *falx major, vel falx cerebri*—is the largest of these septa, and reaches from the foramen cœcum, to the inner protuberance of the occipital bone. It is in the form of a sickle or scythe, being pointed anteriorly, and gradually becoming broader as it passes backwards between the hemispheres, until it reaches and terminates on the tentorium. This process presents a superior convex edge, corresponding, first, to a groove on the frontal bone, then to a groove common to the parietal bones, and lastly, to the vertical groove of the occipital bone. It is in this course hollow, from the separation of the internal from the external lamina of the dura

mater, and lodges the superior longitudinal sinus. Its inferior edge is free and thin, and presents a concavity, which faces towards the corpus callosum, and contains the inferior longitudinal sinus. Anteriorly, the falx major is connected with the crysta galli of the ethmoid bone: and posteriorly, with the tentorium, where it contains the torcular Herophili.

The use of the falx major, is, to support either hemisphere in the lateral positions of the head, and to prevent their injuring each other upon concussion, as well as to contain the longitudinal sinus.

The *tentorium cerebelli, vel septum transversum*—separates the cerebrum from the cerebellum; proceeding from the lateral grooves of the os occipitis, it continues along the angles of the temporal, as far as the clinoid processes of the sphenoid bone; thus dividing the cavity of the cranium into two compartments—the upper for the cerebrum, and the lower for the cerebellum. It allows, however, of the union of these two great portions of the brain, by a semilunar aperture, which corresponds with the pons Varolii. The tentorium presents an upper surface, which is convex, and supports the posterior lobes of the cerebrum; and an inferior concave surface, which lodges the upper part of the cerebellum. Its convexity, or larger circumference, is connected with the grooves of the depressions which lodge the lateral and petrosal sinuses; its smaller circumference, or concavity, is opposed to the superior vermiform process of the cerebellum, the crura cerebri, and the pons Varolii. The tentorium is held in its situation by the falx major, and minor; and both its surfaces are covered by the tunica arachnoidea.

The *falx minor, vel falx cerebelli*—cannot be seen until the cerebrum is removed, and the tentorium cut away from its attachments to the sphenoid and temporal bones; when it will be exposed proceeding by a broad base from the under surface of the tentorium, to the foramen magnum. Superiorly, where it is attached to the tentorium, it assists in forming the torcular Herophili. Posteriorly, its convexity is connected with a groove in the vertical spine of the

occipital bone, and lodges the occipital sinuses. Its concave anterior edge, separates the lobes of the cerebellum. Its uses are to support the cerebellum, to maintain the tentorium, and to form some of the sinuses of the brain.

There are yet two small processes of the dura mater, which pass from the alæ minores of the sphenoid bone into the fissura Sylvii, and serve to enlarge the surface for the support of the anterior lobes of the cerebrum—these have been termed the *sphenoidal folds*.

The vascular system of the brain and spinal cord, presents several peculiarities. The arteries and veins do not accompany each other, and the arterial ramifications run most minutely on the pia mater, before they enter the brain; while the veins which lie in the sulci, between the cerebral convolutions, pass into the sinuses of the dura mater; which constitute the venous circulation of the brain, and correspond to the veins in the rest of the body. These sinuses, produced by the processes of the dura mater, are very irregular in their form. They are lined by the inner membrane of the jugular veins.

In the description of the sinuses, I shall deviate from the usual course, and commence with the ophthalmic veins, which terminate in the cavernous sinuses.

The blood which is conveyed to the eyes, and their appendages, by the arterial ophthalmic ramuli, through the foramina optica, is not returned by any accompanying veins, but by the ophthalmic veins, which pass backwards, through the foramina lacera orbitalia superiora, into the *cavernous sinuses*. They are placed, one on each side of the sella tunica, in grooves on the sides of the body of the sphenoid bone; the dura mater, in this situation, has its laminæ separated by numerous septa, which form it into several compartments,— having not only to receive the refluent blood from the eye, but also to form canals for the third, fourth, first division of the fifth, sixth pairs of nerves, and the internal carotid ramus.

The cavernous sinuses are connected with each other by

two smaller sinuses, which cross the upper part of the body of the sphenoid bone, surrounding the pituitary gland—the refluent blood of which they receive. These sinuses have been termed the *circular sinuses*. Posteriorly, the cavernous sinuses terminate in the superior and inferior petrosal sinuses.

The *inferior petrosal sinuses*—take their course downwards and backwards, in a groove common to the cuneiform process of the occipital, and petrous portions of the temporal bones, to terminate in the commencement of the jugular veins, by passing through the foramina lacera basis cranii. The inferior petrosal sinuses are connected with each other by one or two small sinuses, which cross the cuneiform process of the occipital bone, and are termed the *anterior occipital sinuses*.

The *superior petrosal sinuses*—take their course along a groove upon the acute superior edge of each temporal bone, and terminate in the lateral sinuses, at the junction of the temporal with the occipital fossa—in which the lateral sinuses are placed.

The *superior longitudinal sinus*—is for the purpose of conveying the blood from the hemispheres of the cerebrum; it commences at the crysta galli of the ethmoid bone, and occupies the upper convex edge of the falx major. The opening of this sinus is of a triangular form, and is larger posteriorly, than anteriorly. The upper part or base of the sinus, is formed by the periosteal portion of the dura mater; while the sides and apex, are produced by its inner or cerebral layer; its interior is smooth, and polished in its whole extent, being lined with the internal coat of of the veins.

*Glandulæ Pacchioniæ*—are found on the outer side of the superior longitudinal sinus; there are also some few to be found within the sinus, as well as some little tendinous bands, which cross its cavity, and are termed the *chordæ Willisii*. Upon the sides of this sinus numerous openings, furnished with valves, may be observed, of the several cerebral veins, which pour their blood into it. These openings

are directed from behind to before; consequently, in a different direction to the course of the blood. This arrangement, as well as the existence of the chordæ Willisii, and glandulœ Pacchioniæ, have all been considered as being for the purpose of retarding the flow of blood through the sinus. The superior longitudinal sinus, where it terminates upon the tentorium, either opens immediately into the right lateral sinus, or into a cavity of an irregular form, which is placed at the union of the three great processes of the dura mater. This cavity is termed—

The *torcular Herophili.*—It is of an irregular form, and lined, like the rest of the sinuses, by the internal membrane of the veins. It presents, usually, the following openings— above, from the superior longitudinal sinus; below, from the two occipital sinuses; in front, from the inferior longitudinal sinus; and on either side, from the lateral sinus. Thus the blood of all the sinuses, is pressed through this opening; from which circumstance, the name of torcular Herophili has been given to it.

The *inferior longitudinal sinus*—is much smaller than the superior, and returns little more than the blood of the falx major. It occupies the lower concave surface of the falx major, and takes its course backwards; and when it reaches the junction of the falx major with the tentorium, it loses the name of the inferior longitudinal sinus, and is termed—

The *straight sinus.*—This extends from the termination of the inferior longitudinal, backwards, to the torcular Herophili, occupying the whole space of the attachment of the falx major with the tentorium. It is triangular, and smaller anteriorly than posteriorly. It receives the blood from the inferior longitudinal sinus, as well as from the lateral ventricles, by the venæ Galeni, which are furnished with valves, as they open into the sinus.

There is also some small quantity of blood returned from the upper part of the cerebellum, into the straight sinus.

The *posterior occipital sinuses*—are two of small size,

surrounding the foramen magnum; they commence near the
foramina lacera basis cranii, frequently communicating with
the lateral sinuses, and then pass backward on either side of
the foramen magnum until they reach the spine of the
occiput, where they become situated within the falx cerebelli,
ascending between its layers and terminating in the lower
part of the torcular Herophili. These sinuses convey the
blood from the under surface of the cerebellum, and from
the falx cerebelli.

The *lateral sinuses.*—These conduct the blood which has
been conveyed to the torcular Herophili by the sinuses
already described, to the jugular veins, through the foramina
lacera basis cranii, terminating in them at the jugular fossæ.
They commence from the sides of the torcular Herophili,
opposite to the internal protuberance of the occipital bone,
take their course outward in the transverse grooves of that
bone, pass over the posterior and inferior angle of the
parietal bone, and then gain the groove of the temporal
bone; and just before they reach the foramina lacera, re-
ceive the superior petrosal sinuses, as before mentioned.
In this course, they also receive some small veins from the
cerebellum, posterior lobes of the cerebrum, tentorium, and
while on the temporal bones, from the internal ear.

There are no chordæ Willisii found in their interior, as in
the other sinuses.

Thus we may regard the lateral sinuses as the main trunk
of the venous circulation of the interior of the skull.

*Tunica arachnoidea*—is a serous membrane, placed be-
tween the dura and pia mater, and like all other serous
membranes, forms a closed sac. It presents an exterior
rough surface, connected to the dura and pia mater, and
an internal smooth secreting surface, constantly moistened
by an halitus, for the purpose of preventing the injurious
effects of friction upon motion. It covers the whole surface
of the brain; not, however, passing down with the pia mater,
between the convolutions. Hence to demonstrate this mem-
brane, it is only necessary to introduce a blow-pipe under

the tunica arachnoides, in one of the fissures; and, by inflation, the air will pass between, and exhibit their separation.

This membrane is reflected from the brain to the dura mater, which it lines throughout, excepting at the sella tursica; in which situation, the pituitary gland is placed between the two membranes. It is also reflected from the brain to the dura mater, by processes surrounding the several veins which pass to enter the sinuses; this may be seen more particularly at the superior part of the brain, around the veins entering the longitudinal sinus. At the inferior surface of the brain and medulla oblongata, each nerve is surrounded by a portion of tunica arachnoides, which is reflected upon the dura mater, where the nerve penetrates it; so that the arachnoid membrane forms a *cul de sac*, which closes the opening at the exit of each nerve.

The tunica arachnoides, passes into the ventricles of the brain, giving to them a serous lining; it enters through the foramen of Bichat, which may be seen by pressing the posterior lobes of the brain gently asunder, so as to expose the venæ Galeni at the anterior edge of the tentorium, where they are entering the straight sinus; and immediately underneath these veins, the small round hole will be found, leading to the lateral ventricles, above the pineal gland. This foramen is lined by the tunica arachnoides, which passes forwards into the lateral ventricles, surrounding all the parts contained within them, and proceeding from the lateral, into the third and fourth ventricles. Indeed, to describe each reflection of this serous membrane, would be to enumerate all the irregularities both upon the exterior and interior of the brain; it need only be observed, however, that like the other splanchnic serous membranes, it presents a visceral and parietal portion, shutting out every viscus which it lines from its internal secreting surface.

The *pia mater*—the third tunic of the brain, might with propriety be termed the tunica vasculosa cerebri, as all the arteries, before they supply the substance of the brain,.

ramify most minutely upon this membrane. For this purpose, it dips between the convolutions, and into the cavities of the lateral ventricles, where it is named the plexus choroides. It is in fact, merely a cellular tissue connecting the visceral portion of the tunica arachnoides with the brain, but is separated from the tunic, as it dips down into the sulci between the convolutions. The pia mater enters the descending cornu of the lateral ventricle from the fissura Sylvii, where indeed the plexus choroides commences; and at the foramen of Monro, just at the interior part of the thalami nervorum opticorum, it unites with its fellow from the opposite side. Underneath the fornix, above the tubercula quadrigemina and pons varolii, the pia mater may be seen, passing across from one plexus choroides to the other, closing the fissure between the two thalami, forming what is called the velum inter-positum. This portion is covered by the tunica arachnoidea. Where the pia mater is prolonged into the fourth ventricle, upon the upper surface of the medulla oblongata, it is also invested by a reflection of the tunica arachnoides.

The pia mater, as well as the tunica arachnoidea and dura mater, are all continued upon the spinal marrow; and will be particularly described, when speaking of that portion of the nervous system.

The use of the pia mater, seems to be as a medium of connection between the different parts of the brain, as the cellular membrane is to the other parts of the body; and also to present an extensive surface for the minute division and peculiar arrangement of the blood-vessels of the brain.

### Practical Remarks.

The dura mater, in common with the other structures of the body, is liable to inflammation, either from wounds or other injuries, as well as from the extended effects of inflammation, proceeding from the exterior coverings of the skull. Indeed, this latter cause may be considered as the most common, in consequence of the frequent inosculation of the blood-vessels of the pericranium with those of the dura mater, as well as the greater exposure of the former to external injuries.

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When inflammation attacks the dura mater, its effects are so violent and sudden, that it rarely proceeds beyond the adhesive stage, for the patient generally sinks before the formation of pus; and upon examination after death, a layer of adhesive matter will be found connecting the dura mater and the tunica arachnoides, sometimes only confined to one spot, while at others it will be more extensive, or even general.

When suppuration does take place, the matter is usually found between the dura mater and the skull; and this is generally the effect of external injury—producing, at first, inflammation of the pericranium, and its separation from the bones of the skull; and subsequently, the separation of the dura mater from the interior of the skull, and the formation of abscess. In such cases, the matter presses on the brain, and will necessarily destroy life, unless means are adopted by which the matter may be successfully evacuated.

The symptoms come on insidiously, and frequently after injury to the skull, when the patient appears to have arrived at a convalescent state, he suddenly becomes comatose, from the formation of matter between the dura mater and skull.

This state of insensibility, however, is usually preceded by a rigor; under these circumstances, therefore, the head should be shaved, the scalp examined with the greatest precaution, and if any puffiness can be discovered, an incision is to be immediately made down to the bone; which if it be found denuded, dry, and of a white color, denoting its death, that part may be removed with a trephine—indicating the almost invariable situation of the matter.

Pus sometimes forms in the longitudinal sinus, or makes its way into it from the extension of inflammation; in these cases, there is usually matter found in other situations, leading to a fatal termination.

Serum also forms between the dura mater and tunica arachnoides, or more properly, within the secreting cavity of the latter tunic; this occurs, as in the other splanchnic serous membranes, either from an increased action of its blood-vessels, or diminished power of the absorbents. The disease is named hydrocephalus externus, and is of rare occurrence. If the bones of the head be completely ossified, the quantity of fluid collected, is never more than three or four ounces—producing, during its formation, violent symptoms; but if it occurs at such an early period of life that the bones of the head are not yet completely ossified, the quantity of fluid accumulated may amount to fourteen or fifteen ounces. This disease frequently leads to the formation of spina bifida, which it effects by its pressure preventing the bones of the spine consolidating; so that a tumor is produced in the course of the spinous processes of the vertebræ—the fluids pushing the membranes of the spinal marrow before it.

This disease Sir Astley Cooper made the subject of his particular investigation, and he first attempted to cure it by pressure; but he soon found that this treatment tended to produce either paralysis of the lower extremities, and even sometimes to lead to symptoms of apoplexy. He then tried the effects of puncturing the tumor with a small needle, and evacuating its contents—repeating the operation upon the re-appearance of the tumor, at the same time using gentle pressure. This method has been attended with success, in three or four instances; but with every precaution, puncturing the membranes sometimes leads to incurable ulcerations, purulent discharge, and a subsequent fatal result.

The dura mater, like other fibrous structures, is liable to fungoid tumors, which frequently produce absorption of the animal parts of the bone, giving it a porous appearance; the earthy parts are next absorbed, when a fungoid tumor makes its appearance externally.

The dura mater is also liable to earthy depositions, several specimens of which we have in the museum at Guy's Hospital. Such depositions lead either to epilepsy, inordinate action of the heart, disordered action of the stomach and chylopoetic viscera, accompanied with a tendency to violent irritation of mind, and leading sometimes even to insanity.

It is remarkable, that the train of symptoms arising from this cause resemble very much the symptoms attending earthy depositions upon the coronary arteries, or on the valves of the larger arteries arising from the heart. Indeed, the symptoms are so similar, as frequently to cause considerable difficulty in forming a just diagnosis.

The tunica arachnoides, very rarely presents any morbid appearances, although the deposition of adhesive matter, which is so frequently attributed to the dura mater, is likely to be the result of inflammation of this serous membrane.

The pia mater, is more subject to inflammation than the dura mater; in which state, it frequently exhibits a very high degree of vascularity —an appearance almost invariable in those persons who die of phrenitis. When suppuration follows, the matter is found between the brain and its membranes; and this is most frequently produced by ill-treated diseases of the ear. I have myself seen, and could quote numerous instances, in which inflammation of the pia mater suddenly came on from the application of highly stimulating injections in diseases of the ear.

The pia mater, is comparatively rarely the seat of any other disease than inflammation. Sir Astley Cooper, however, has recorded a case, which occurred to a patient of his in Guy's Hospital, who died of chorea, in whom earthy matter was found deposited upon the pia mater.

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# LECTURE XXXII.

## DESCRIPTIVE ANATOMY OF THE BRAIN.

THE brain, or encaphalon, is placed within the cranium, and is composed of a soft pulpy mass, enclosed within the membranes, which have been described.

This pulpy substance was formerly considered to be composed of a homogenious mass of medullary matter; but experiments and physiological observations prove, that it is no longer to be so considered; but that its different parts are destined to convey different influences, and to receive impressions peculiar to themselves; and that the organ, therefore, is to be viewed as complex in its structure, and various in its functions.

The brain is divided by a mezian line, passing in a direction from before to behind, into two equal parts; but this separation is not occurring in every part of the brain; for in several situations, the parts corresponding on either side, are brought into communication in the middle line by processes of brain, termed commissures. There are also other fissures besides these longitudinal ones, which separate portions of the brain in a transverse direction; these are more particularly to be observed on the base of the brain, producing such distinct separations, as to have led to the division of the brain into four distinct parts: the cerebrum, cerebellum, pons varolii, and medulla oblongata. These parts, together with the medulla spinalis, we shall first describe generally, pointing out the several appearances to be observed upon their exterior, and then proceed to the more important structures which characterize their interior.

## Of the Exterior of the Cerebrum.

The *cerebrum*—forms the largest portion of the brain, and occupies the whole of the upper part, and the anterior and middle portions of the base of the cavity of the cranium, leaving only the lower and posterior part of the base for the cerebellum, from which it is separated by the tentorium. The cerebrum occupies the space included above a plane, bounded by the upper edge of the annular protuberance of the pons varolii before, and by the lower edge of the inferior corpora quadrigemina behind; and all below this plane is occupied by the cerebellum.

The cerebrum weighs, according to the late Dr. Gordon of Edinburgh, from thirty-five to forty-five ounces avoirdupois. Its length is from six inches and a quarter to six inches and a half: its breadth from five inches and a quarter to five inches and a half: and its depth from two inches and three quarters to three inches. As to its form, it varies in different subjects; still these varieties are but slight: it is somewhat ovoid, convex above, somewhat compressed laterally, and flattened below. Its posterior extremities are larger than the anterior.

Upon the upper surface of the cerebrum, a deep longitudinal fissure separates it into two halves, which are denominated the two hemispheres. This longitudinal fissure is not of the same depth in its whole extent; being one inch and three quarters in front, where it extends completely to the basis of the skull; behind, it extends to the tentorium, separating the posterior lobes of the brain, and is from two inches and a half to two inches and three quarters deep; while in the middle it does not extend to the base of the brain, but reaches no farther than the corpus callosum, and is not more than one inch in depth. This fissure is occupied by the falx major.

Each hemisphere forms the fourth of a solid ovoid: the divisions of which are marked by the longitudinal fissure above, and by the plane already mentioned as separating

the cerebrum from the cerebellum, below. The only devia-
tion from this fourth of an ovoid figure, is the projection of
the under surface of the middle lobe of the cerebrum.

The surface of each hemisphere is marked by numerous
serpentine ridges, with corresponding depressions between
them: the former being termed convolutions or gyri; the
latter, fossæ or sulci. The convolutions pass in various
directions, present different forms and sizes, and are from a
quarter to one inch broad. They are, in general, of compa-
rative small size in young children: and it is to be observed,
that the convolutions are not symmetrical in any two corres-
ponding points of the two hemispheres. The fossæ or sulci
are as variable as the convolutions in form, size, numbers,
and direction. They vary from each other with respect to
their depth; some being superficial, while others extend an
inch deep. All of them are lined by prolongations of the
pia mater. On separating these sulci, in some of them it
will be observed, that secondary convolutions pass into them,
so as to produce considerable irregularities in their form.

It has been observed by Bichat, that the irregularities of
the surface of the hemispheres, have no corresponding irre-
gularities upon the under surface of the bones of the
skull.

The lower surface of the cerebrum, which is composed of
the bases of the two hemispheres, has been divided by ana-
tomists into distinct regions, termed the lobes—which are
three in number on either side, and are denominated the
anterior, middle, and posterior lobes. The surfaces of these
lobes are marked by convolutions and sulci, similar in their
general appearance to those on the upper surface; but they
are smaller, less serpentine, and more shallow.

The anterior lobe of each hemisphere is the largest of the
three, and extends backwards the distance of one half the
hemisphere. It is somewhat flattened generally, but yet
presents a slight depression, which is concave from side to
side, to correspond with the convexity of the orbitar plates
of the frontal bone, upon which it rests. The inner edge of

each anterior lobe is formed of a projection produced by the inner boundary of a fossa, which lodges the olfactory nerve; and between the ridges of the two sides, the great longitudinal fissure of the cerebrum is placed, and the falx major commences.

The middle lobe of the brain forms a very considerable prominence beneath the plane of the anterior lobe, and fills the deep fossæ in the middle region of the basis of the skull. It is convex on its outer and lower surface, and is separated from the anterior lobe by a deep fissure, termed the fissura Sylvii; which corresponds to the posterior edge of the ala minor of the sphenoid bone, and lodges the ramulus arteriosus medius cerebri. This fissure is various in its length in different subjects, and usually not wider than the sulci between the convolutions, excepting just at its commencement anteriorly. This fissure extends backwards and inwards, nearly at a right angle, into another fissure, which runs longitudinally—bounded on the outer side by the middle lobe of the brain, and, internally by the optic nerves and crura cerebri. It is this fissure which admits of the passage of the pia mater into the lateral ventricles, but the opening is closed by the tunica arachnoides.

The posterior lobes are not so well defined as the middle, and anterior, the middle lobe being insensibly connected with it. A line, however, drawn across the lower surface of cerebrum, immediately behind the posterior extremity of the corpus callosum, at a right angle with the longitudinal fissure, will form the anterior boundary, to the posterior lobes of the brain. The lower surface of this lobe rests upon the tentorium, and can only be seen on the base of the brain by raising the cerebellum and tentorium from it, when it will be found to be concave, and face a little inwards. The posterior lobe of one side is separated from the other, as has already been described, by the longitudinal fissure.

In taking a general view of the under surface of the cerebrum, we observe its anterior lobes separated by the

longitudinal fissure, which extends backwards as far as a pyramidal eminence, which closes it posteriorly.

The base of this pyramidal eminence is directed backwards, and its apex forwards: its anterior sharp edge is inserted like a wedge between two convolutions. From its lower surface, three striæ of white medullary matter extend backward: of these, the outermost is the longest, and extends to the fissura Sylvii; the middle one passes rather more inwards, towards the mesian line; while the internal one, which is the shortest but broadest, bends gently upwards and backwards, to the posterior extremity of the longitudinal fissure, and becomes connected with the corpus callosum. To the point of this pyramidal eminence, the olfactory nerve is attached.

Immediately behind this eminence is placed a flat surface of medullary matter, extending outwards and backwards from the pyramidal eminence to the fissura Sylvii: it forms, as it were, the posterior and under surface of the anterior lobes. It is partly covered by the inner lobule of the middle lobe of the brain, and the commissure of the optic nerves, which must be raised to show it to its full extent, when it will be seen to be pierced by a number of small holes.

The *commissure of the optic nerves*—is next to be observed, which is situated immediately beneath the portion of brain just described, and is formed partly by the union, and partly by the decussation of the fasciculi of these nerves. From the commissure posteriorly there proceeds the trunk of the optic nerve, on either side, which winds at first backwards and outwards, then turns inwards, under the crus cerebri, becoming flatter as it passes backwards to the point where it arises; which will be hereafter described. This portion of brain, has been termed the tractus opticus, and is covered in the greater part of its extent by the inner edge of the middle lobe of the brain. Immediately behind the commissure of the optic nerve, is placed a portion of medullary matter, which is termed the *tuber cinereum*, and which passes backwards to the corpora albucantia, being

bounded laterally by the anterior extremities of the crura cerebri. The upper surface of the tuber cinereum, forms a part of the floor of the third ventricle. Its inferior surface is attached to the *infundibulum*, which is a process of reddish medullary matter, that extends downwards and forwards to the pituitary gland, which is placed in the sella tunica of the sphenoid bone, between the dura mater, and tunica arachnoides.

The *pituitary gland*—the use of which is entirely unknown, is a dense substance, of an irregular figure, and somewhat like a gland ; it is divided unequally into two portions, the anterior of which is the larger and firmer.

Immediately behind the tuber cinereum, two small, white, rounded bodies, about the size of peas, will be seen, which are termed—

The *corpora albucantia*, or *processus mammillares.*— They are placed in apposition with one another, and are connected by a thin process of grey matter; these bodies form the terminations of the anterior crura of the fornix    Behind, and between them, the pons varolii, and the crura cerebri, there is placed a triangular process of medullary matter, which is termed—

The *substantia perforata*, or *pons Tarini*—it forms a part of the floor of the third ventricle, and is perforated by small foramina.

The *crura cerebri*, are the last parts to be described on the under surface of the cerebrum, which may be shewn without dissection. They are two rounded bodies, about three-quarters of an inch in length, which extend from the pons varolii, passing forwards to the under surface of the hemispheres, in which they seem to be lost. As they leave the pons varolii, the crus cerebri of the one side is close to that of the other ; but as they pass forwards to the hemispheres, they diverge, the interspace being filled up by the pons Tarini.

## Of the Exterior of the Cerebellum.

The cerebellum forms the second division of the central mass of the nervous system. It is much smaller than the cerebrum, being less than a third of its size. In the adult, it is estimated at one-eighth of the weight of the cerebrum, and in a new-born infant, only one-seventeenth.

It is lodged in the inferior fossa of the occipital bone, below the tentorium. Its exterior presents a reddish grey color, and its consistence is less firm than that of the cerebrum; instead of convolutions, it is divided by a number of concentric lamellæ, which are termed folia cerebelli; they are from a line to a line and a half in thickness, and enclose one another, so that if a sulcus be opened between any two of them, several other lamellæ will be found between, smaller and more irregular in their form. The cerebellum is divided into two lateral lobes, posteriorly by a fissure which receives the falx minor, and anteriorly by the deep depression of the medulla oblongata.

The upper surface of the cerebellum is flat, inclined obliquely backwards and outwards, and presents in its middle and fore part a projection, which is termed—

The *processus vermiformis superior*—produced by the union of the lamellæ of the two sides of the hemispheres of the organ

There appear to be from sixty to seventy folia, which compose the upper surface of the cerebellum.

The inferior surface of the cerebellum, presents a deep fissure, in which is lodged, anteriorly, the commencement of the spinal marrow; while posteriorly, it is divided into two, by an eminence termed—

The *processus vermiformis inferior.*—This is made up of several short transverse folia, which present, anteriorly, a process which has been termed the mammillary process.

On each side, the cerebellum presents on its inferior surface a convex rounded lobe, divided into four smaller lobules, which describe concentric arches, ending in the middle depression.

The circumference of the cerebellum is interrupted, anteriorly and posteriorly, by the two notches, which have been already described, as containing the falx minor, and commencement of the medulla oblongata. On each side of the posterior notch, the circumference of the cerebellum presents a distinct projecting lobule, composed of laminæ resembling the other lobes of the cerebellum.

### Of the Exterior of the Pons Varolii.

This part of the brain, may be considered as a centre of communication between the cerebrum, cerebellum, and medulla oblongata; it presents a quadrilateral figure, its length, breadth, and thickness, being nearly equal. Its anterior and under surface is composed of transverse fibres, passing from the cerebellum and forming a commissure between its two lobes, in the centre of which it is marked by a broad horizontal line, in which is placed the ramulus basilaris. It embraces the crura cerebri, passing partly around them like a ring, from which it has been sometimes termed the tuber annulare.

The posterior and upper surface of the pons varolii, is entirely concealed by the under surface of the cerebellum; it is connected with the tubercula quadrigemina; but as these parts cannot be demonstrated without dissection, we shall defer their minuter description until we examine the internal organization of the brain. The anterior extremity of the pons varolii, is bounded by the crura cerebri; the inferior, which is smaller, is bounded by the spinal marrow; while laterally, it is connected with the cerebellum.

Having enumerated the various parts upon the exterior of the brain, and pons varolii, I shall next describe the coverings of the spinal marrow.

### Of the Coverings of the Medulla Spinalis.

The *dura mater*—passes through the foramen magnum into the vertebral canal, forming a membranous sheath to enclose the spinal marrow.

The external surface of the dura mater spinalis, does not adhere to the vertebræ, but forms a sheath, free from the motions of the bony canal which contains it. Anteriorly, it forms a slight connection with the posterior surface of the common proper posterior ligament of the bodies of the vertebræ; but here there is comparatively so slight a motion, that it does not interfere with the functions of the spinal marrow. On the sides of this sheath, openings may be observed through the dura mater for the passage of each nerve arising from the spinal marrow; and as they descend, they become wider and more oblique, so as to resemble canals, more than foramina. It is within these canals that the anterior and posterior filaments unite to form one nerve, around which the dura mater forms an envelope, which having passed through the vertebral foramen, is lost in the common cellular tissue; not becoming continuous with the periosteum of the vertebræ, as the dura mater does with the pericranium in passing through the foramina of the skull.

The internal surface of the dura mater vertebralis, is lined by the tunica arachnoides.

At the sacrum and os coccygis, the dura mater vertebralis terminates, by being connected to those bones, by some irregular fibrous bands.

The *tunica arachnoides*—of the spinal marrow, is reflected from its surface upon the dura mater, in the same manner as within the skull from the brain. Laterally, the arachnoid membrane gives off an envelope to each nerve, which passes with it into its dura matral canal, as far as its exit, when it is reflected, and forms a *cul de sac*, closing the opening.

It is reflected in a similar manner, from the anterior and posterior spinal vessels, upon the dura mater; and on arriving at the lower extremity of the spinal marrow, it forms a long cylindrical canal, which passes to the extremity of the sacrum, where it terminates by sending coverings to the bundles of the lumbar and sacral nerves, and being reflected from them to the dura mater.

The *pia mater*—forms a prolongation from the brain to the spinal marrow, similar to the other membranes; becoming, immediately it has passed through the foramen magnum, thicker, stronger, and of a paler color: having now a new function to perform, namely, that of protecting the spinal marrow from the motions of the spinal column. It is in close contact with the medulla spinalis, and forms an immediate investment or neurilema to the spinal nerves. Cloquet, from the difference of color and thickness in the pia mater spinalis, from that of the brain, seems inclined to consider it as a separate structure; but its continuity from the head to the spinal column, does not warrant such a division.

These three membranes are common to the brain, and spinal marrow; but the latter is also furnished with membranes, which are proper to it; and according to Cloquet, the pia mater is classed in this order.

The *ligamentum dentatum*.—From the spinal marrow being suspended within the canal formed by the dura mater, it is necessary that it should have some ligamentous structures to maintain its situation, and it is the ligamentum dentatum which performs this office. It is continued from the foramen magnum, to the inferior extremity of the spinal column: in this course presenting from twenty to twenty-two processes or denticulations, between the points at which the nerves pass out of their dura matral sheath. The first process is attached to the margin of the foramen magnum, and is placed between the vertebral artery and the lingual nerve; the last, is between the twelfth dorsal and first lumbar nerves.

This membrane has been considered as a prolongation of the pia mater; but it appears to be a distinct structure, although connected with it by means of dense cellular membrane. The form of these denticulations is triangular, the bases being attached to the pia mater of the sides of the spinal marrow, between the anterior and posterior filaments of the spinal nerves; and their apices are connected to the

dura mater:—the surfaces of the membrane being covered by the tunica arachnoides, which may be separated by sufflation.

### Of the Exterior of the Spinal Marrow.

The spinal marrow commences at the pons varolii, and terminates at the first or second lumbar vertebra — the greater part of it being enclosed in the vertebral canal. In a full grown adult, it is about thirty inches in length; it differs in thickness in different parts of its extent, but is not more than an inch thick in any part ; and its diameter is about half an inch. A portion of the spinal column is within the skull, resting on the cuneiform process of the occipital bone. Hence the division of the spinal marrow, into medulla oblongata, and medulla spinalis.

The weight of the spinal marrow, varies—being in the adult, from 1-19th to 1-25th part of that of the brain; while in the new-born infant, it is not more than 1-40th part. In its extent it varies in size, being first large, where it commences from the pons varolii, from which it is separated by a distinct and deep fissure.

In the upper part of the cervical region, it is contracted ; but as it gains the fourth cervical vertebra, it becomes again enlarged—contracting a second time at the seventh cervical vertebra. In the upper part of the dorsal region, its bulk increases, diminishing in size as it descends, until it terminates by an oval tubercle, which is variable in size and form.

The *medulla oblongata*—commences at the pons varolii, and terminates at the foramen magnum; its anterior surface rests upon the cuneiform process of the occipital bone, and is more rounded than its posterior surface.

This portion of the spinal marrow, is divided into six distinct pillars by sulci; the anterior sulcus, which is much deeper above than below, continues along the whole extent of the spinal marrow, and divides it into two distinct pillars. At the upper part of these pillars, are the *corpora pyra-*

*midalia;* they extend from the pons varolii to the atlas, as very distinct enlargements, placed between the corpora oli- varia; but below this point, they are much less obvious. And about an inch below the pons varolii, some of the fibres of the corpus pyramidale of one side, cross obliquely the anterior fissure, to join those on the opposite, producing a decussation; it is only the inner fibres, or those nearest to the sulcus, which decussate; while the outer ones continue uninterruptedly upward, through the pons varolii, into the cerebrum, in a manner hereafter to be described.

The two lateral pillars, have eminences on their upper portions, termed the *corpora olivaria*—which are separated from the anterior pillars by a superficial groove. They are about an inch in length, of an oblong form, larger in their centre than at their extremities, and of a white color. Their upper extremity has been described by some anato- mists, to terminate abruptly at the pons varolii; but it will be hereafter shewn, that it passes through the pons varolii to the corpora quadrigemina. The posterior surface of the spinal marrow, at its upper extremity, is divided by a deep fissure, termed the calamus scriptorius, into two pillars, termed the corpora restiformia—which we shall hereafter find contribute to the formation of the cerebellum.

According to Sir Charles Bell, there is a fissure separating the corpora restiformia from the corpora olivaria—and which is continued from the lower extremity of the corpora olivaria, containing a white line, which separates the anterior from the posterior pillars, in the whole course of the spinal marrow. It is less obvious below than above, but does not extend into the pons varolii. This, Sir Charles Bell has termed the tractus respiratorius; it gives origin to the nerves regulating the motion of the respiratory muscles.

The spinal marrow below the medulla oblongata, which has already been mentioned as not being of the same size throughout, is divided into pillars by the continuation of the anterior and posterior sulci, into which the pia mater enters. By minute examination both of the anterior and posterior

surface, little transverse grooves may be seen, which are more distinct behind than before; particularly in the space between the last cervical and ninth dorsal vertebra.

From the spinal marrow thirty-one pairs of nerves arise, which are symmetrical, double-rooted, and receive distinct filaments from the anterior and posterior pillars: by the former of these, the power of motion is communicated; while in the posterior root, resides that of sensibility. For this remarkable physiological fact, one of the greatest discoveries of modern times, we are indebted to Sir Charles Bell.

Having considered the exterior appearances of the centres of the nervous system, we shall now proceed, by dissection, to investigate their interior, and more intimate organization.

*Of the Interior of the Brain.*

This dissection may be prosecuted, either according to the old method of demonstrating the parts from the superior to the inferior surface; or according to the plan of Doctors Gall and Spurzheim, of tracing the connection of the pillars of the spinal column from the basis into the interior of the brain; or according to the mode of Dr. Foville, of Rouen, which I shall afterwards point out more particularly by a diagram. Notwithstanding the evident superiority, in a scientific point of view, of the plan adopted by Doctors Gall and Spurzheim; still, in consequence of the delicacy of manipulation, and the number of brains required to follow the fibres through every part, I find it more advantageous to teach the anatomy of the brain according to the old plan; adding, at the same time, to the names given to individual parts, their continuity according to the demonstrations of the above-named anatomists.

To demonstrate the interior structures of the brain, we commence by separating the hemispheres of the cerebrum from each other, at the longitudinal fissure; by which we expose, in the centre of this fissure, a mass of white medullary matter, from three to four inches in length, and nearer to the frontal than to the occipital bone, called the *corpus*

*callosum.* This view being very limited, the next part of
the dissection consists in cutting off each hemisphere on a
level with the corpus callosum; . which is effected, by
passing the knife under the overlapping edges of the hemi-
spheres, which have been termed their labia, and directing
the section outwards, in such a manner as not to open the
lateral ventricles.

The hemispheres being removed, on either side of the
corpus callosum may be observed, that peculiar arrangement
of white medullary matter forming the centre, and of grey
or dark cortical substance which forms the exterior. This
general view is termed the centrum ovale, which term is
useless, beyond the denomination of a mere appearance.

The structure of the medullary and cortical parts should
now be examined. The *medullary* is the denser of the two,
and its greater firmness seems to depend on its being
supplied with less fluids than the cortical part. In this
section, the medullary substance presents a greater mass
than the cortical, and exhibits numerous delicate red spots,
from the division of its minute blood-vessels.

In many situations, the medullary substance of the brain
is evidently fibrous. With respect, however, to its minute
organization, there is but little known: some anatomists,
have considered it solid; others, tubular; while there are
those, who maintain that it is made up of a number of small
globules: still, however, admitting it to be fibrous, we are
ignorant of its ultimate structure.

The *cineritious* or cortical substance, is a soft, spongy,
vascular matter, and of a grey color; it not only forms
the exterior of the brain, but is also found distributed
with the white medullary matter within the interior of the
organ. It has been considered to be composed entirely of
blood-vessels, probably from its red color in children, its
grey appearance in old age, and from its colorless state in
dropsical and emaciated persons. Its color is destroyed by
maceration, acids, and alcohol. When examined by the
microscope, it appears to be composed of minute globules;

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but its ultimate structure is as little known as that of the medullary part. Doctors Gall and Spurzheim have given it as their opinion, that the cortical part is the matrix of the medullary filaments; but this hypothesis is overthrown at once, by the fact, that in the developement of the brain, the cortical part is not formed first, but subsequently to the medullary. Dr. Foville considers it as the chief seat of the mind, or the perceptive part of the brain; while the fibrous medullary substance, he considers, conveys impressions, both to and from the perceptive parts.

Having taken this view, the corpus callosum again claims our attention.

The section of the hemispheres having been completed, the whole of the upper surface of the corpus callosum is brought into view; it is arched from before backwards; its anterior extremity is smaller than the posterior, the former being half an inch, the latter three quarters of an inch broad.

Along the mesian line, a little projection may be observed, which is bounded on either side by little furrows; the intermediate longitudinal ridge is termed the *raphé;* it is made up of longitudinal fibres intersecting the transverse fibres of connection, between the hemispheres and corpus callosum, and is supposed by Gall and Spurzheim to be for the purpose of forming a longitudinal commissure, or bringing into reciprocal influence the anterior and posterior fibres of the hemispheres; while the transverse fibres act from side to side. Dr. Foville, however, has a different view with respect to the formation of the corpus callosum, and considers it as the immediate commissure of the crura cerebri, rather than that of the hemispheres; but as he admits of the transverse fibres of the hemispheres being connected with the corpus callosum, it is clear that this body must be equally a commissure to both parts.

The longitudinal furrows, have been described as being formed by the pressure of the blood-vessels of the corpus callosum; but as the edges of these grooves are composed

of longitudinal fibres, they appear rather to be a distinct formation, which assists in producing the longitudinal commissure.

Transverse fibres may be distinctly observed extending from these, as well as from the raphé, into the hemispheres; the anterior fibres passing obliquely forwards and outwards, the posterior outwards and backwards, and the middle taking a transverse course.

The anterior extremity of the corpus callosum, may be seen upon separating the anterior lobes of the brain from each other, to bend downwards and backwards, being connected on either side with the anterior lobes, and in the middle it passes completely into the base of the brain, to be connected with the tuber cinereum and optic commissure.

The posterior extremity of the corpus callosum, may be viewed by separating the posterior lobes of the cerebrum, when it will be found broad, and a little concave, and bent downwards to be connected inseparably with the fornix, and the hippocampi majores. The under surface of the corpus callosum, forms the roof of the lateral ventricles of the brain, which are next to be laid open and examined.

The mode of opening them is to make an incision on either side of the raphé, about two inches and a half in length, leaving a space of about a fourth of an inch between the two incisions; and then by turning the roof on either side outwards, in the manner of a flap, the two lateral ventricles are exposed, with the portion of the corpus callosum left, separating the one from the other.

The ventricles which we have thus laid open, present a quadrilateral figure, and contains the following parts.

First, the *corpora striata:* these are pyriform bodies, having large round extremities in front, converging towards each other, while their posterior extremities are pointed, and pass backwards and outwards. They are vascular, and present a cineritious or cortical surface; when cut into, however, they consist of alternate layers of cineritious and medullary matter, the latter of which may be traced from the crura

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cerebri, through the corpora striata, to the anterior parts of the cerebrum. Gall and Spurzheim, from the intermixture of the cineritious with the medullary matter in these bodies, have considered them as ganglia, from which the anterior parts of the hemispheres of the brain are produced; and term them, therefore, the anterior or superior cerebral ganglia.

Behind the corpora striata, and between their posterior diverging crura, are placed—

The *thalami nervorum opticorum*—which are considered by Gall and Spurzheim as the posterior, or inferior cerebral ganglia ; a comparatively small portion of these can only be now seen ; they are firm white bodies, presenting an external medullary smooth surface, but are cineritious within, as we shall hereafter have occasion to describe. At the point of junction between the thalami nervorum opticorum and the corpora striata, there may be observed a semi-transparent, white, fibrous substance, commencing at the anterior extremity of the optic thalamus, and being directed backwards curves downwards, gradually contracting until it is lost upon the corpus geniculatum externum. This line is termed the *tænia semi-circularis*, and perhaps may be considered as a commissure between the thalami and corpora striata.

In this stage of the dissection, the next and last parts to be observed within the lateral ventricles, are the *plexus choroides*. It is but a small portion, however, of them which can be now seen; they are composed of blood-vessels, connected with each other by pia mater, and overlap the tæniæ semi-circulares, and consequently the point of junction between the thalami and corpora striata.

By prosecuting the dissection a little farther, we shall find that the lateral ventricles become more extensive, namely, by projecting forwards and outwards, to form the anterior cornua ; backwards and inwards, to produce the posterior cornua ; and backwards, outwards, downwards, forwards, and inwards, to form the descending cornua.

The *anterior cornua*—pass outward, consequently di-

verging from each other, and surround the anterior extre-
mities of the corpora striata, which they are said to contain;
as well as the converging fibres of the inferior convolutions
of the anterior lobes, which are passing to the anterior ex-
tremity of the corpus callosum.

The *posterior cornua*—proceed backwards into the poste-
rior lobes of the cerebrum, converging in their course, and
contain some fibres of medullary matter, which have received
the name of the *hippocampus minor;* but these are, in fact,
the converging filaments of the posterior lobes, passing to
the corpus callosum.

The *inferior cornua*—as may be supposed, from the in-
tricate direction they take, are difficult to lay open; but the
knife may always be directed, by following the course of the
plexus choroides.

The parts to be observed in each of these cornua, are, a
continuation of the plexus choroides, the tænia hippocampi,
the hippocampus major, terminating in the pes hippocampi;
and outside of these parts, the eminentia collateralis.

The *plexus choroides*—which is found in this cornu, is
continuous with that found in the body of the lateral ven-
tricles; it passes into the interior of the brain, at the
anterior extremity of the descending cornu, from the fissura
Sylvii; and in its course upwards, towards the body of the
lateral ventricle, it covers the pes hippocampi, tænia hippo-
campi, and hippocampus major, in succession.   This plexus
must be raised, to expose—

The *tænia hippocampi, or corpus fimbriatum*—or poste-
rior crus of the fornix, which passes downwards along the
concave edge of the hippocampus major, towards the pes
hippocampi—terminating, however, before it reaches it.

*Hippocampus major*—or cornua ammonis, is composed of
a large projection, which is curved upon itself, presenting a
convexity outwards and backwards, and a concavity forwards
and inwards.  Its superior surface is free, being within the
lateral ventricles, and covered by the plexus choroides; its
posterior extremity divides into two sets of fibres, to be

connected with the corpus callosum, and with the hippo-campus minor of the posterior cornu. Its anterior extremity, which is situated in the anterior and inferior extremity of the descending cornu, close to the fissura Sylvii, is broad and bulbous, marked with furrows, which, from a fancied resem-blance, has been termed the pes hippocampi. Its under surface is connected with the convolutions of the middle lobe of the brain, and its concave inner edge is covered by the tænia hippocampi, or corpus fimbriatum, which we shall find hereafter to be a continuation of the fornix; between the tænia hippocampi, and the concave edge of the hippocampus major, a narrow cineritious line may be observed, which has been termed the *corpus denticulatum.* The hippocampus major is to be considered, therefore, as bringing into connec-tion the inferior convolutions of the middle lobes of the cerebrum, with the corpus callosum.

The *eminentia collateralis*—is nothing more than the outer wall of the posterior part of the descending cornu, formed by a projecting convolution of the middle lobe of the cerebrum.

It is to be remembered, that in the opening of the lateral ventricles, a portion of the corpus callosum was left, forming a division between the two lateral ventricles; by raising this cautiously with the handles of two knives, a layer of semi-transparent medullary matter will be observed, passing downwards to be connected with the fornix; so that, in fact, the corpus callosum, the fornix, and the connecting medul-lary layer, termed the *septum lucidum*, form a separation between the two lateral ventricles.

To examine these parts more minutely, the corpus cal-losum should be cut transversely, and one half should be turned forwards and the other backwards; under the ante-rior portion a lamina will be found on either side, connect-ing the corpus callosum with the fornix, and beyond it, the upper with the lower portion of the corpus callosum; the space between these two laminæ, being termed the fifth ventricle.

The corpus callosum is next to be traced, as we have hitherto only spoken of its superior surface. Anteriorly, it will be seen to pass downwards, within the great longitudinal fissure, winding around the anterior rounded extremity of the corpus striatum, forming there the anterior boundary of the lateral ventricle, passing under the corpus striatum, to form the anterior part of the floor of the same cavity, and terminating in the base of the brain, by being connected with the tuber cinereum. The corpus callosum, posteriorly, terminates by being connected with the fornix, the hippocampus major, and the hippocampus minor.

The *fornix*—rests upon the pia mater, which separates it from the thalami nervorum opticorum; it should now be cut through near its centre, and reflected backwards and forwards, in the same manner as the corpus callosum; the posterior crura may be traced, passing backwards behind the thalami, downwards and outwards upon the hippocampus major; terminating in the descending cornu of the lateral ventricle, by what has already been named the tænia hippocampi. Upon the under surface of the posterior portion, a few prominent striæ, placed obliquely with respect to each other, may be observed, which are produced by the blood-vessels of the pia mater; and this appearance has been termed the lyra Davidis.

By the anterior portion of the fornix being directed forwards, it is seen to be divided into two cylindrical bodies, termed the anterior crura; these separate more from each other as they pass forward, between the two thalami nervorum opticorum, behind the anterior commissure, to terminate in the corpora albicantia in the base of the brain. Just as these anterior crura are bending downwards, between the anterior extremities of the thalami, they leave an opening behind them, and underneath the origin of the tæniæ semicirculares, by which the lateral ventricles communicate with the third, and where the plexus choroides meet to terminate in the venæ Galeni. This has been termed the foramen of

Monro; but its existence as an opening, is doubtful in the healthy state of the organ.

The fornix, when viewed under the corpus callosum, and resting upon the pia mater which covers the thalami, presents a triangular figure, with its base behind, and apex or narrow part in front; and from covering the third ventricle, has been termed the fornix: although it is to be remembered, that the pia mater which is under the fornix, forms the real roof to the third ventricle, proceeding from one plexus choroides across to the other, and forming what is termed the *velum inter-positum;* in the middle of which veins may be observed, passing to form the vena magna Galeni, which is directed backwards, between the posterior lobes of the cerebrum, and the cerebellum, to terminate in the torcular Herophili.

To prosecute the dissection still farther, the plexus choroides, with the velum inter-positum, are to be raised from the upper surfaces of the thalami nervorum opticorum, when the whole of those bodies will be brought into view.

Each thalamus nervi optici, presents an upper surface, within its corresponding ventricle; an inferior surface, forming the roof of the descending cornu of each ventricle; an external edge, connected with the corpus striatum, and the hemisphere of its own side; and an internal edge, which is directed towards the opposite thalamus. On the posterior extremity of each thalamus, are placed two slight projections, which are termed—

The *corpora geniculata*—these are connected by medullary striæ to the corpora quadrigemina. The outer projection, or corpus geniculatum externum, is also united with the origin of the optic nerve.

The outer or contiguous edge of the thalamus with the corpus striatum, presents the grey line, which has already been described under the name of the tenia semi-circularis; and on its inner edge, a white fasciculus may be seen passing backwards, as will be hereafter described.

The space between the two thalami, presents a cavity or a longitudinal fissure, which is termed—

The *third ventricle*—this is bounded above, by the velum inter-positum; below, by the tuber cinereum, and pons Tarini; and laterally, by the thalami nervorum opti-corum. In this cavity, there are also to be observed the following parts—three commissures, the anterior crura of the fornix, and four openings.

The *middle or soft commissure*—may be exposed by separating the thalami nervorum opticorum, gently from each other. It is of a whitish grey color, connecting the thalamus of the one side with the other. In front of this commissure, and before the descending anterior crura of the fornix, is placed a white, transverse, cylindrical cord, termed the anterior commissure. This sinks into the substance of the hemispheres, extending laterally through the corpora striata, in which bodies they are lost.

The third ventricle, is also bounded behind by a *posterior commissure*, which is thicker and shorter than the anterior, but of the same form and direction, extending a few lines on either side into the thalami nervorum opticorum.

The space between the anterior edge of the middle commissure and the anterior commissure, is termed the *foramen commune anterius*; and the space between the posterior edge of the middle, and the posterior commissure, is termed the *foramen commune posterius*. Besides these, there are two outlets or passages from the third ventricle—the one placed beneath the anterior commissure, and between the two anterior crura of the fornix, leading downwards to the pituitary shaft, and is named the *iter ad infundibulum*. It is formed into a *cul de sac*, by a reflection of the tunica arachnoidea. There is also a second passage, which is placed immediately under the posterior commissure, and which leads through the aqueduct of Sylvius to the fourth ventricle; this is named the *iter a tertio ad quartum ventriculum*.

The next step to be taken in the dissection of all those

parts of the brain which can be seen from the upper surface,
is to tear the pia mater farther back, which passes over the
pineal gland and corpora quadrigemina, in order to expose
them. This, however, is facilitated by cutting off the pos-
terior lobes of the cerebrum.

The *pineal gland*—rests upon the upper surface of the
superior two of the corpora quadrigemina, which are some-
times called the *nates*. This gland is of a greyish color, of
a soft pulpy consistence, and variable in form. At its fore
part, it receives the two white cords, which have already
been described as running along the inner edge of each
thalamus, under the name of the peduncles of the pineal
gland, and which, as it were, holds it in its situation. The
use of this small body, is entirely unknown ; and what is
most extraordinary, it contains a considerable quantity of
silicious matter, in the form of minute sandy particles, of
different sizes, and variable in its quantity in different sub-
jects. The pineal gland should now be raised, so as to
expose entirely the corpora quadrigemina, which will be
found to be connected in front with the thalami nervorum
opticorum, and inferiorly with the processus ad testes and
the valve of Vieusens. These bodies are found only in the
mammalia; reptiles, and birds having but one pair of tu-
bercles.

Above the tubercula quadrigemina, between them and the
under surface of the fornix and corpus callosum, the fissure
of Bichat is placed, through which the tunica arachnoides
passes to line the ventricles. By raising the superior vermi-
form process of the cerebellum, two rounded white cords
may be seen, proceeding from the cerebellum to the inferior
or smaller bodies of the corpora quadrigemina, called also
the *testes*. These cords are termed the *processus e cerebello
ad testes*—which are united to each other by a white medul-
lary band or layer, forming a commissure to these processes;
it is called the valve of Vieusens, and may be readily de-
monstrated by passing a blow-pipe under the posterior
commissure of the third ventricle, into the iter a tertio ad

quartum ventriculum; when, by inflation, the roof of this iter, or the valve of Vieusens will be raised.

These are all the parts of the brain which can be traced and examined from its upper surface: to prosecute, therefore, the dissection of the cerebellum and pons varolii, we must commence from the base of the brain, tracing its structure from the spinal marrow.

The *spinal marrow*—as we have already observed, is formed of a substance differing in consistence, at different periods of life. Its exterior presents a layer of white medullary matter, which contains cineritious matter in its interior—an arrangement the reverse to that of the brain. In making a transverse section of the spinal marrow, the cineritious matter is divided into a middle, and two lateral portions; the first is transverse, and is thicker and broader in the cervical than in the dorsal region, and again enlarges in the lumbar region. The two lateral portions are curved, their convexities facing towards each other, and their concavities outwards. Their posterior edges, are prolonged nearly to the posterior collateral grooves; while anteriorly, they are shorter and thicker.

The *corpora olivaria*—are covered, like the rest of the spinal marrow, with white medullary matter; and in their substance they contain a dark cineritious matter, which has been termed the corpus dentatum.

It has been asserted, that a canal runs through the whole length of the centre of the spinal marrow, proceeding from the calamus scriptorius; but others have supposed, that this is merely produced by artificial means.

Gall and Spurzheim, describe a canal in each lateral portion of the spinal column, commencing in the lumbar region, and continuing upwards, through the whole length of the spinal marrow, into the pons varolii, under the tubercula quadrigemina; and passing through the crura cerebri, finally enter the thalami nervorum opticorum, in the interior of which, they state they may be inflated to a considerable size: but the early progress of developement being now

so well understood, it is proved that these canals do not exist.

By following the pillars of the spinal marrow into the substance of the brain, we shall be enabled to explain the manner in which these pillars are at least connected with, if not producing the cerebellum, pons varolii, and cerebrum. We shall commence with—

The *posterior pillars*, or *corpora restiformia*—which proceed upward and outwards from the medulla oblongata into the cerebellum. A portion of these fibres also continue forward, beyond the cerebellum, to be connected with the corpora quadrigemina, termed the processus e cerebello ad testes; while a third portion of the medullary matter of the cerebellum, crosses transversely on the under surface of the pons varolii, to be connected with the opposite lobe of the cerebellum—producing its great commissure.

Thus it may be said, that the medullary part of the cerebellum is made up of three sets of fibres of medullary matter. The one proceeding upwards and outwards, from the spinal marrow; the second, forwards, to the corpora quadrigemina; and the third, inwards, on the pons varolii: each of these being connected with that of the opposite side, by distinct commissures.

The corpora restiformia, where they diverge from each other to enter the lobes of the cerebellum, leave a space which is called the fourth ventricle; in which may be observed a white medullary band, crossing from the one restiform body to the other, producing the commissure between the two. The second commissure, is that portion of medullary matter connecting the processus cerebello ad testes, which is named the valve of Vieusens : while the third, the great commissure of the cerebellum, forms the transverse fibres of the under surface of the pons varolii.

The whole of the medullary matter of the cerebellum, is surrounded by a cortical substance, which presents different appearances according to the sections which are made. Thus, if the transverse fibres forming the great commissure

be traced in the direction of their course, by a lateral section of one of the lobes, the large medullary mass will be exposed ; in the centre of which is a rounded grey substance, of an inch in length, termed—

The *corpus rhomboideum, vel serratum*—and which has been considered by Gall and Spurzheim, as the great ganglion of the cerebellum, for the production of its medullary fibres. It was the appearance of this substance, which led to the controversy between Dr. Spurzheim, and the late Dr. Gordon, of Edinburgh.

If a vertical section be made of one lobe, a particular arrangement of the cortical and medullary matter is presented to view; which has obtained the name of the *arbor vitæ*, from its foliated appearance.

The cerebellum encloses the fourth ventricle, the roof of which is formed by the valve of Vieusens; the sides, by the processus e cerebello ad testes, and by the cerebellum; and the floor, by the corpora restiformia of the medulla oblongata. Into this opening the pia mater enters, and is here sometimes said to form a plexus choroides minor.

We may next trace the organization of the cerebral protuberance, named the *pons varolii*—which is the smallest part of the brain; it is placed between the cerebrum, cerebellum, and medulla oblongata, and is intimately connected with each of these parts.

The under or anterior surface, has already been noticed, as being made up of the transverse fibres forming the great commissure of the cerebellum.

If these fibres be scraped off, they will be found to be crossed by longitudinal fibres, passing from the corpora pyramidalia, and the corpora olivaria ; of the distribution of which, various accounts have been given by different anatomists. Those from the corpora olivaria, according to Gall and Spurzheim, pass through the pons varolii, upon the upper and inner surface of the crura cerebri, to form, with a continuation of the corpora restiformia, the thalami nervorum opticorum, and posterior lobes of the cerebrum ; while,

according to Dr. Foville, they go no farther than the corpora quadrigemina. The other longitudinal fibres, which enter into the structure of the pons varolii, are a continuation of the corpora pyramidalia, and pass forward from it, forming the under part of the crura cerebri, in which they are separated from the fibres of the corpora olivaria and corpora restiformia, by a portion of grey matter, termed the *locus niger*. This grey matter, according to Gall and Spurzheim, is the ganglion of the crura cerebri, and is considered by them as the origin of its medullary enlargement.

We have already mentioned, that the crura cerebri are connected by a commissure, named the pons Tarini.

The further account of the distribution of the fibres of the crura cerebri, according to the views of Dr. Foville, will be better explained by a plate, to which ample references are given, than by any separate description.

# LECTURE XXXIII.

THE nerves are divided into those which are connected immediately with the brain, and those which arise from the spinal marrow.

Those from the brain, or the cerebral nerves, are distributed to the organs of sensation and volition. They arise in pairs, and are named according to the order of their succession.

The *first pair are the olfactory*—which are placed upon the under surface of the anterior lobes of the brain, in grooves, which protect them from the pressure of that organ. They arise by three distinct filaments, which may be traced for a considerable distance into the substance of the brain; the outer filament is white, the longest of the three, and is directed outwards and backwards into the fissura Sylvii, which in a great measure conceals it. This filament can be traced into the lateral ventricle, arising from the corpus striatum. The inner filament is also white, is shorter than the outer one, and may be traced backwards as far as the anterior part of the corpus callosum. The middle filament is grey or cineritious, has a pyramidal figure, and where the three filaments unite, the olfactory nerve presents a triangular form.

It is closely connected to the under surface of the anterior lobes of the brain, by the arachnoid membrane; as it passes forwards, it gradually enlarges to a bulbous extremity, from the lower surface of which it distributes its filaments to the nose.

The olfactory nerve of the one side, converges towards that of the opposite; and while they rest upon the cribriform plate of the ethmoid bone, they divide into an external, internal, and middle set of rami.

The external principally supply the superior turbinated bones, frequently uniting with each other: the internal ramify upon the pituitary membrane, covering the nasal process of the ethmoid bone: while the middle rami are distributed upon the pituitary membrane, covering the under surface of the roof of the superior chamber of the nose.

The olfactory nerves differ from the other cerebral nerves, —first, in having three distinct filaments by which they arise, from converging as they pass forward, from being lodged in a groove of the brain, from having no neurilema, from passing through the several foramina; and it is also said by Cloquet, that they do not anastomose with other nerves— but this is to be considered as a matter of doubt.

There is no nerve in the body which offers greater difficulties, in physiological reasoning, than the olfactory, whether we are following the views of Sir Charles Bell, Majendie, Gall and Spurzheim, or Dr. Foville; for they all, more or less, agree in the belief that the cerebrum, which is most intimately connected with the corpora pyramidalia, is for the function of motion, the cerebellum for sensation, and the corpora quadrigemina for organic life. Now this nerve, which arises from the cerebrum, has attributed to it, entirely the sense of smell; nor can we for a moment hold with Majendie, who by experiment, tried to prove that it was the fifth pair of nerves, and not the first, which gives the sense of smell. But may it not be, that the cineritious filament, which this nerve derives from one of the posterior convolutions of the brain, communicates a distinct influence?

The *second pair of nerves*, are the *optic*—they arise from the tubercula quadrigemina, and are peculiar from having a much longer course within, than on the exterior of the skull; and from not furnishing a single branch, from its origin to its termination; it receives two distinct filaments

from the superior and inferior corpora quadrigemina, which
pass outwards, beneath the thalamus nervi optici; the su-
perior filament being connected with the corpus geniculatum
externum, the inferior filament with the corpus geniculatum
internum.  These filaments then unite to form a soft flat
band, which takes its course outwards, and then winding
forwards under the crus cerebri in a semi-circular direction,
forms what is called the tractus opticus.  In passing
under the crus cerebri, it is connected with it by its outer
convex edge; but its inner concave edge is free.  When
it arrives anterior to the crus cerebri, it proceeds farther
inwards, and escapes from the fissure of the middle lobe of
the brain, here becoming more rounded, and resting upon
the tuber cinereum, to which it adheres.  Just anterior
to the pituitary gland, the two optic nerves unite, so as to
form a commissure: and much difference of opinion has
arisen, whether or not the optic nerves here decussate; the
truth, however, seems to be, that some of the fibres decus-
sate, some continue onwards on the same side, while others
pass across to the opposite optic nerve, both before and after
their union—thus forming the anterior, and posterior edges of
the commissure. The optic nerves, after having produced this
commissure by the crossing and interlacement of their fila-
ments, again separate, being now cylindrical, and perfectly
free from any attachment to the brain, and each is directed
forwards and outwards to the foramen opticum of its own
side, through which it passes, with the ramulus a. ophthal-
micus—above and to the outer side of which vessel it
lies.  In the second part of its course, each optic nerve is
enveloped in a distinct neurilema; but before the formation
of the commissure, it is only covered by pia mater, and tunica
arachnoides upon its under surface.  In passing through the
optic foramina, each optic nerve is surrounded by the four
straight muscles of the eye, from which it is separated by
a considerable quantity of fat, by the ciliary nerves and
vessels, and by the ophthalmic ganglion; when the optic
nerves arrive at the posterior, internal and inferior part of the

Q

eye, they suddenly contract, traverse the sclerotic and choroid membranes, and terminate by expanding into the retina. From the foramen opticum to their termination, numerous small partitions divide the medullary matter of the nerve into distinct fasciculi, passing from the inner surface of the neurilema.

The optic nerve does not enter the globe of the eye in the direction of its long axis, but to its nasal side; nor does it perforate the sclerotic coat through one foramen, but through a cribriform plate.

(3.) The *motores occulorum*, or the *third pair of nerves*—arise from the crura cerebri, as far backwards as the point where the corpora pyramidalia issue from the pons Varolii, forming the upper or anterior part of the tractus motorius of Sir Charles Bell. They also receive grey filaments from the substantia perforata, or pons Tarini.

This nerve issues from the substance of the brain, between the posterior cerebral, and the superior ramuli of the cerebellum. Immediately after its origin, it forms a rounded cord, acquiring consistence from a neurilema, which envelopes it. It takes its course forwards and outwards, to the body of the sphenoid bone, where it penetrates the dura mater to gain the cavernous sinus, at that point losing its covering from the tunica arachnoides. While within the cavernous sinus, it first lies above and to the inner side of the fourth pair, and first division of the fifth pair of nerves; but just at the anterior clinoid process, it is covered by these two nerves, which cross it obliquely, and in their turn become internal to it. It is separated from the ramus a. carotidis internus, by a process of dura mater; just before it enters the orbit, through the foramen lacerum orbitale superius, it divides into a superior and an inferior ramus; the superior, the smaller of the two, passes over the optic nerve, and divides into ramuli to supply the superior rectus muscle, and the levator palpebræ superioris; the inferior, or larger ramus, is beneath and to the outer side of the optic nerve, and the rectus inferior oculi, where it divides into three

ramuli, the largest of which is the inner one, and supplies the adductor oculi; the middle one ramifies upon the rectus inferior muscle; while the third and outer ramulus takes the longest course, passes under the ball of the eye to supply the inferior oblique muscle: just at the origin of this ramulus n., a small filament arises, which gains the outer side of the optic nerve, to be connected with the ophthalmic ganglion.

The peculiarity in the distribution of this nerve, is, that although described as a common motor to the eye, it does not supply the adductor oculi, or the superior oblique, while it does furnish a ramus to the inferior oblique muscle.

Sir Charles Bell considers the oblique muscles as involuntary; but if so, here is an instance of an involuntary muscle being supplied by a voluntary nerve: the ramus n., however, which goes to this muscle, is connected with the ophthalmic ganglion, and may therefore, perhaps, be considered as a compound nerve.

(4.) The *nervi pathetici, or fourth pair.*—The nervus patheticus of each side, arises from the valve of Vieusens, by three or four filaments, which unite and form the smallest of the cerebral nerves, passing out just on the outer side of the junction of the crura cerebri with the pons Varolii.

Sir Charles Bell traces the medullary substance of this nerve to the space between the corpora olivaria and corpora restiformia, at the upper part of the tractus respiratorius. As soon as it has emanated from the junction of the crura cerebri with the pons Varolii, it descends, passing outwards and forwards under the crura cerebri, along the inner edge of the tentorium; and having arrived at the posterior clinoid process of the sphenoid bone, it enters the cavernous sinus, penetrating the dura mater, and here losing its arachnoid covering. While within the cavernous sinus, it is first placed below, and to the outer side of the motor oculi, but is separated from it, by a process of dura mater; the nerve then passes forwards towards the foramen lacerum orbitale superius, through the widest part of which, it enters the orbit, and passes above the motor oculi.

The nervus patheticus then inclines upwards and inwards, passes over the superior rectus, and levator palpebræ superioris muscles, being here accompanied by the frontal ramulus of the ophthalmic branch of the fifth pair of nerves; it divides into two or three rami, which are distributed to the superior oblique muscle.

This nerve is peculiar in being distributed to a single muscle of the eye; and Sir Charles Bell is the first physiologist who has attempted to explain its function. Having traced the nerve from the tractus respiratorius, he considers it as the respiratory nerve of the eye; and instances, in proof of his theory, the peculiar expression of the eye, concomitant with violent and difficult respiration.

(5.) The *nervus trigeminus, or fifth pair of nerves.*— This nerve arises by two distinct sets of filaments, the one communicating sensation, and the other motion; and like the spinal nerves, the posterior filaments form a ganglion, while the anterior ones pass out unconnected with it.

The origins of this nerve, should be traced backwards from the place where it first makes it appearance exterior to the pons Varolii, when it will be found, that the anterior fibres can be followed through the pons Varolii, to the corpus pyramidale of its side; while the posterior fibres forming the larger root, take a course downwards and backwards, through the pons, to the corpus restiforme—from which it derives the property of sensation. These filaments uniting as they issue from the substance of the pons Varolii, consist of from eighty to a hundred filaments, collected in one neurilema. It then passes on to the summit of the petrous portion of the temporal bone, and there piercing the dura mater, gains the anterior surface of that bone, where the posterior filaments expand into the Gasserian or semilunar ganglion. While the anterior roots pass beneath the ganglion, without uniting with it, to reach the foramen ovale, by which it passes out of the skull, forming a part of the third division of the fifth pair of nerves. The circumstance of the unganglionic branch passing to supply muscles, as well as its

origin from the corpus pyramidale, proves the justness of Sir Charles Bell's theory, regarding the function of this nerve.

The Gasserian ganglion is of a crescentic form, presenting its convexity in a direction forwards and downwards, from which three distinct nervous rami are distributed.

(A.) *Ramus nervosus ophthalmicus*—is the smallest of the three branches; it proceeds forwards from the upper part of the ganglion, under the dura mater, towards the cavernous sinus, which it enters, being separated from the third and fourth pair of nerves by a distinct process of that membrane; being at first placed inferior to those nerves, but afterwards passing above them. While within the cavernous sinus, the ramus ophthalmicus receives one or two filaments from the sympathetic nerve, and almost immediately after divides into three ramuli.

(a.) *Ramulus nervosus lachrymalis*—is the smallest and most external and inferior of the three; it penetrates the dura mater above the nervus motor oculi, and passes into the orbit through the foramen lacerum orbitale superius, taking its course on the outer wall of the eye, between the periosteum and abductor oculi, to the lachrymal gland, to which it is distributed, supplying at the same time the upper eyelid.

In this course, the ramulus n. lachrymalis sends off two ramusculi—

(α.) The *ramusculus n. spheno-maxillaris*—which is reflected from the ramulus n. lachrymalis, close to its origin, and passes downwards to unite with a ramusculus of the second division of the fifth pair of nerves.

(β.) The *ramusculus n. malaris*—takes its course outwards, through a foramen in the malar bone, to reach the cheek, where it unites with filaments of the facial nerve.

(b.) *Ramulus n. frontalis*—is the largest of the three ramuli of the ophthalmic ramus, takes its course upwards and inwards, above the levator palpebræ superioris muscle, accompanied by the nervus patheticus; and here it divides into two ramusculi; the inner one—

(α.) *Ramusculus n. supra-troclearis*—passes forwards and inwards along the superior oblique muscle of the eye, as far as its cartilaginous pully, supplying the muscles and skin on the inner canthus, and being lost upon the forehead; it unites in its course, with the ramulus n. lachrymalis, and the ramulus n. nasalis of the ophthalmic ramus.

(β.) The *ramusculus n. supra-orbitalis*—directly it is separated from the ramulus n. frontalis, upon the upper surface of the levator palpebræ muscle, directs itself forwards and upwards to the supra orbitar foramen, through which it passes to gain the forehead, and supply the upper eyelid, uniting with branches of the portio dura, supplying also the corrugator supercilii muscle, and being ultimately lost upon the forehead and vertex.

(c.) *Ramulus n. nasalis*—enters the orbit by a separate foramen of the dura mater, and passes between the two heads of the abductor oculi muscle; it then proceeds upwards, forwards, and inwards, passes over the optic nerve, and under the levator oculi muscle, where it sends off, or rather receives—

(α.) A ramusculus from the ophthalmic ganglion—after which it divides on the inner wall of the orbit, into two ramusculi.

(β.) *Ramusculus n. nasalis internus*—is sent off opposite to the foramen orbitale internum anterius, through which it passes to gain the interior of the skull; then enters a bony groove on the upper surface of the cribriform plate of the ethmoid bone, along which it runs to a small fissure upon its anterior extremity, and passes through it, to gain the interior of the nose, dividing there into filaments, some of which are distributed to the pituitary membrane, and others to the integuments at the extremity of the nose.

Sneezing, from the effects of the light of the sun to the eye, and the overflow of tears, upon the application of pungent bodies to the nose, are attributable to this nerve.

(γ.) *Ramusculus infra-trochlearis*—proceeds forwards continuing in the direction of the ramulus nasalis, under the

superior oblique muscle of the eye ; at the inner canthus of which, and beneath the trochlea, it emerges and divides into numerous filaments, uniting with the infra-orbitar ramuli, and with filaments of the portio dura; supplying also the caruncula lachrymalis, the lachrymal sac, and the exterior of the nose.

(B.) *Ramus n. maxillaris superior*—forms the second division of the fifth pair of nerves; it arises from the centre of the convexity of the Gasserian ganglion, from which it is directed forwards, slightly outwards, and leaves the skull by passing through the foramen rotundum of the sphenoid bone, and enters the spheno-maxillary fossa, which is bounded, above, by the orbit, below, by the pterygo-maxillary canal, in front, by the tuberosity of the superior maxillary bone, behind, by the pterygoid foramen, on the inner side, by the spheno-palatine foramen, and on the outer, by the malar bone. While within this fossa, this ramus receives two filaments from Meckel's ganglion, which is situated below it, and within the spheno-maxillary fossa ; and almost immediately after, it gives off the—

(a.) *Ramulus n. orbitalis*—which ascends, passes through the spheno-maxillary fissure, and gains the orbit, within which, under the depressor oculi muscle, it sub-divides into two ramusculi—the malar and temporal.

(α.) The *ramusculus n. malaris*—is directed upwards and outwards, and unites with the ramulus n. lachrymalis, then passes through a foramen in the malar bone, and is distributed to the muscles and skin of the cheek, uniting with the portio dura ;

(β.) The *ramusculus n. temporalis*—penetrates the orbitar process of the malar bone, gains the temporal fossa, where it unites with the deep temporal ramusculi of the ramus n. maxillaris inferior; it afterwards pierces the temporal aponeurosis, becomes sub-cutaneous, and accompanies the ramulus arteriosus temporalis superficialis, unites with filaments from the portio dura, and is ultimately lost on the skin of the temple and head.

The next ramulus sent off from the ramus nervosus maxillaris superior, is usually distributed by two or three ramuli called—

(b.) The *ramuli n. dentales posteriores*—which are given off behind the tuberosity of the superior maxillary bone, wind around it, and enter small foramina, which perforate the substance of the bone to reach the roots of the three or four last molar teeth; usually one of these ramuli pass externally, without entering the bone, to supply the gums; and another enters the antrum Hymorianum, and is distributed upon its membrane.

(c.) *Ramulus n. infra-orbitalis.*—This ramulus appears as a continuation of the main branch, passes through the spheno-maxillary fissure, and enters immediately either a canal or foramen in the orbitar process of the superior maxillary bone, which canal terminates externally in the infra-orbitar foramen, where this ramulus divides into numerous infra-orbitar ramusculi: they are distributed in an external and an internal set, supplying the under eyelid, the caruncula, and lachrymal sac, skin and muscles of the nose, and are united with filaments of the portio dura.

While the infra-orbitar ramulus is passing on the floor of the orbit, it sends off the—

(a.) *Ramusculus n. dentalis anterior*—which descends into the antrum, runs to the fore part along its lining membrane, and ultimately supplies the incisor and canine teeth. Within the antrum, this ramusculus supplies the mucous membrane, and unites with filaments of the posterior dental ramusculus.

(c.) *Ramus n. maxillaris inferior*—is the third division of the fifth pair of nerves, and the largest of the three branches; it proceeds from the lower part of the convexity of the Gasserian ganglion: but upon more minute inspection, it will be found to be composed of two sets of fibres, the anterior of which are the softest, flattened, and really emanate from the Gasserian ganglion; while there are fibres concealed by these, larger, whiter, and rounded,—composed

of parallel, and not plexiform filaments,—which emanate from the corpora pyramidalia.

These two sets of filaments pass together through the foramen ovale, to gain the zygomatic fossa; in which situation, those filaments of the ramus which had been posterior, wind around the others, and become anterior. When the ramus n. maxillaris inferior has gained the zygomatic fossa, it is placed between the pterygoideus externus muscle, and the pterygoid process of the sphenoid bone ; and here it divides into a superior and an inferior ramulus.

(*a.*) *Ramulus n. superior.*—This is placed external to the other, and gives origin to four sets of muscular ramusculi. The first of these supply the posterior surface of the temporal muscle, and are termed—

(*z.*) *Ramusculi n. temporales profundi.*—These are usually two in number, pass upwards upon the periosteum of the temporal fossa, and behind the temporal muscle, in the substance of which they ramify ; some, however, pass through its fibres and fascia, to unite with ramifications of the portio dura, as well as with the ramulus n. lachrymalis of the first division, and ramulus n. orbitalis of the second division of the fifth pair of nerves.

(*β.*) *Ramusculi n. masseteres*—(not unfrequently given off in a single branch) take their course outwards, above the pterygoideus externus muscle, pass through the sigmoid notch of the inferior maxillary bone, and supply the masseter muscle. . They send also some few filaments to the temporo-maxillary articulation.

(*γ.*) *Ramusculi n. buccales*—are larger than the preceding, and are directed forwards and downwards, first between the two pterygoid muscles, and then between the pterygoideus internus and the ramus of the lower jaw ; it passes in front of the coronoid process, and enters the buccinator muscle, which it supplies, as well as the levator anguli oris muscle, and the skin of the cheek and lips.

These ramusculi frequently unite with those of the portio

dura, and the ramulus n. infra-orbitalis of the second division of the fifth.

(δ.) *Ramusculi n. pterygoidei*—are two or three in number, are distributed to the pterygoid muscles, and principally to the internal.

(*b.*) *Ramulus n. inferior*—the remaining branch of the third division of the fifth, divides itself into three ramusculi; the first of these, the—

(α.) *Ramusculus n. lingualis, vel gustatorius*—immediately after its division, descends between the pterygoid muscles, and here sends off a filament of communication with the inferior dental ramusculus; and then the corda tympani unites with it; which is a branch from the spheno maxillary, or Meckel's ganglion, and not as was formerly supposed, either a branch of the second division of the fifth, or of the portio dura. The corda tympani, passes with the gustatory ramusculus, first between the pterygoideus externus, and circumflexus palati muscles, then between the pterygoideus internus, and the ramus of the lower jaw, reaching the submaxillary gland, on which it is finally distributed.

The gustatory ramusculus, however, continues on under the mucous membrane of the mouth, between the mylohyoideus, and hyo-glossus muscles—being here accompanied with the submaxillary duct; it then ascends above the sublingual gland, and divides into several filaments, which terminate in the papillæ conicæ at the anterior part of the tongue. This ramusculus, during its course sends filaments of communication to the hypoglossal nerve, to the internal pterygoid muscle, and to the sublingual gland.

(β.) *Ramusculus n. dentalis inferior*—is rather longer than the preceding; it descends between the pterygoideus internus, and internal lateral ligament of the temporomaxillary articulation, and the ramus of the lower jaw, which latter is to its outer side. When it reaches the middle of the internal surface of the ramus of the lower jaw, and just before it enters the posterior dental canal,

it sends off the *mylo-hyoideal filament,* which is always protected by a distinct groove in the bone; it passes forwards upon the mylo-hyoideus muscle, distributes filaments to it, as well as to the submaxillary gland, and the anterior belly of the digastric muscle.    The ramusculus nervosus dentalis inferior, then enters the posterior maxillary foramen, accompanied by an arterial and a venous ramusculus, all being protected from the action of the pterygoideus internus muscle, by the internal lateral ligament of the temporo-maxillary articulation.    The nervous ramusculus continues through the mental canal appropriated to it in the lower jaw, immediately beneath the roots of the teeth, extending from the last to the first molar tooth, distributing filaments to them; it then reaches the anterior mental foramen, and divides into two filaments, one of which still continues within the bone, as far the symphysis of the lower jaw, supplying the canine and incisor teeth, and uniting with the filament from the opposite side, in the middle line of the jaw; the other, or internal filament, passes out of the mental foramen, gains the face, and ramifies on the chin and lips, uniting frequently with filaments from the portio dura.

It may here be remarked, that we have described the ramusculus supra orbitalis, of the first division of the fifth, the ramusculus infra orbitalis of the second division, and the ramusculus dentalis inferior of the third division of the fifth, each in passing through their appropriate foramina, and uniting with the portio dura within a perpendicular line.

(γ.) *Ramusculus n. auricularis, vel temporalis superficialis*—frequently arises by several filaments, which surround the ramusculus arteriosus meningeus medius, and then uniting form one cord, which passes between the condyle of the lower jaw and meatus auditorius externus, being here deeply seated in the substance of the parotid gland; it sends off a filament to the temporo-maxillary articulation, and then divides into several other filaments, which communicate with the portio dura; some of them supply the auricle of the ear, and others lose themselves upon the temple and

forehead, uniting frequently with the temporal filaments of the facial, and the occipital filament of the second pair of cervical nerves.

(6.) The *sixth pair, or abducentes*—arise from the corpora pyramidalia, or anterior pillars of the spinal marrow, just inferior to the groove, placed between the medulla oblongata and the pons Varolii; from this point each nerve passes forwards and upwards, on either side of the ramulus arteriosus basilaris, to gain the cavernous sinus, which they enter by passing through the dura mater immediately beneath the posterior clinoid processes; when within the cavernous sinus, each abductor nerve is placed external to the internal carotid ramus, where they receive two or three filaments from the superior cervical ganglion of the sympathetic nerve. The sixth pair of nerves still pass forwards (enclosed within a sheath of dura mater, which separates them from the blood contained within the sinus,) to the foramina lacera orbitalia superiora, through which they pass on either side into the orbit, between the two origins of the abductor muscle, accompanied by the third, and ramulus n. nasalis of the ophthalmic branch of the fifth pair, being ultimately distributed to the abductor muscle by three or four distinct filaments.

(7.) The *seventh pair—portio dura, or facial nerve—* arises from the space between the corpus olivare and corpus restiforme, on either side of the medulla oblongata, close to the lower margin of the pons Varolii. According to Sir Charles Bell, it arises immediately below the origin of the fourth pair; it is above the portio mollis, and to the outer side of the sixth pair, from which it is separated by the corpus olivare. Immediately after its origin, it forms a flat, soft, white cord, which is not immediately enclosed in a neurilema; it continues its course upwards and outwards, accompanied by the portio mollis, which in part receives it in a groove, and they together enter the meatus auditorius internus. Having reached the base of this opening, the portio dura separates from the portio mollis, and enters the

canal of Fallopius, which takes a course upwards, outwards, downwards, and backwards, and terminates ultimately in the stylo-mastoid foramen, through which the portio dura runs, and issues from it, to be spread upon the face. Almost immediately after the portio dura has entered the canal of Fallopius, it receives upon its inferior surface, the *videan or nervus innominatus*—which is a filament from Meckel's ganglion, and forms the corda tympani, which will be more particularly described, when speaking of the sympathetic nerve.

While the portio dura is taking its course through the canal of Fallopius, it sends off two rami—

(A.) *Rami musculares*—one of which is distributed to the tensor tympani, and the other to the stapedius muscle. The next branch in the course of the dissection to be described, would be the chorda tympani; but for the doubt which exists, whether it is to be considered as arising from the portio.dura, after that nerve has received filaments from the nervus inno-minatus; or as the nervus innominatus itself, without having united with the portio dura. I shall prefer describing it as a branch of the sympathetic; for although I believe in the union of the two, it may still be considered as a branch of the sympathetic, communicating a compound, as well as a reciprocal influence to the portio dura.

After the portio dura has given off these two muscular branches, it continues its course through the canal of Fallo-pius, and passes out of the foramen stylo-mastoideum, deeply seated within the substance of the parotid gland; in which situation, it sends off three rami.

(B.) *Ramus auricularis posterior*—takes its course upwards and backwards, upon the anterior surface of the mastoid process, and there divides into an anterior and a posterior ramulus; the anterior passes upwards, in front of the meatus auditorius externus; while the posterior passes behind, both to be distributed to the skin, and muscles of the external ear, uniting with filaments of the cervical plexus.

(c.) *Ramus n. stylo-hyoideus*—expends itself upon the

stylo-hyoideus, and the digastricus. muscles, being also connected with filaments of the sympathetic, from the superior cervical ganglion, as well with some from the cervical plexus.

(D.) *Ramus n. digastricus*—takes its course outwards and backwards, to be distributed to the posterior belly of the digastric muscle ; but also, a considerable branch, passes through it, and divides into two ramuli, one—

(*a.*) *Ramulus n. superior*—rises upwards and inwards, passes behind the internal jugular vein, and unites with the glosso-pharyngeal nerve, just as it escapes from the foramen lacerum basis cranii.

(*b.*) *Ramulus n. inferior*—descends, and passing slightly forwards, unites with the superior laryngeal branch of the par vagum.

After the portio dura has given off these rami, and still while embedded within the parotid gland, it divides into numerous branches, which are frequently uniting with each other, so as to form a complete plexus, which has been termed the *pes anserinus ;* and from which there are sent off other branches, proceeding in three distinct sets, in different directions. The first branch, ascends to cross the zygoma, and join the temple ; from which course, it is called the—

(E.) *Ramus n. temporo-facialis*—it passes upwards within the substance of the parotid gland, towards the neck of the lower jaw, where it divides into seven or eight ramuli, which are named according to their destination.

(*a.*) *Ramuli n. temporales*—are two or three in number, which pass upward, crossing the zygoma to gain the temple, where they divide into several ramusculi, to supply the temple, the vertex of the head, the front part of the ear, and the muscles and skin of these regions ; uniting with· filaments of all the three divisions of the fifth pair of nerves, and with those of the cervical plexus.

(*b.*) *Ramuli n. malares*—are also two or three in number; they take their course upwards to the malar bone, where they divide into numerous filaments, to be distributed to the

muscles connected with that bone, as the orbicularis palpe-
brarum, and the zygomatici ; and unite with the branches of
the first and second divisions of the fifth pair.

(c.) *Ramuli n. buccales*—are usually first distributed as
three or four ramuli, which take their course transversely,
crossing the masseter muscle, and there sub-dividing into
three distinct sets of ramusculi : the *superior*, to supply the
sides of the nose, and muscles of the upper lip; the *middle*,
take their course principally with the parotid duct, and ulti-
mately are distributed to the buccinator, and the other mus-
cles of the commissures of the lips; while the *inferior*, are
distributed to the lower lip, uniting with the dental filaments
of the third division of the fifth.

(F.) *Ramus n. cervico-facialis*—is a branch of consider-
able size, and passes obliquely downwards, behind the
ascending ramus of the lower jaw, where it divides into two
sets of ramuli.

(a.) *Ramuli n. supra-maxillares*—as the name implies,
are distributed to the face ; but they divide into a superior
and an inferior set: the *superior*, leave the parotid gland,
by which they are at first concealed, cross the masseter
muscle, and dividing into four or five ramusculi, ramify on
the platysma myoides depressors of the lower lip, and the
skin; while the *inferior*, turn over the angle of the lower
jaw, and supplying the insertion of the pterygoideus internus,
are distributed as the preceding ramusculi, uniting with
filaments of the second and third divisions of the fifth pair.

(b.) *Ramuli n. infra-maxillares*—are two or three
in number, and descend forwards to the anterior and su-
perior part of the neck, dividing into several ramusculi, to
supply the platysma myoides and integuments, frequently
uniting with filaments from the cervical plexus, and with
those of the preceding ramuli.

On taking a view of the distribution of the portio
dura, it will be found to supply all the muscles of the face,
and to be frequently uniting with the filaments from each
division of the fifth pair of nerves, which are also dis-

tributed to the same parts as the portio dura. Sir Charles
Bell, struck with this fact, directed his mind to the physiology
of this arrangement, and has come to the following conclu-
sion:—That the fifth pair, arising by two distinct sets of
filaments or roots, are capable, like all the spinal nerves, of
communicating both sensation and motion to the parts which
they supply ; but that the motion which is communicated by
the fifth pair, is the motion subservient to the will, while they
are under another motatory influence, essentially connected
with respiration ; and which influence is communicated to
them through the portio dura, arising from the tractus respi-
ratorius.

(8.) *Eighth pair, portio mollis, or auditory nerve*—arises
from the upper surface of the corpus restiforme, from a small
grey band which connects it with the floor of the fourth
ventricle. The roots which give origin to this nerve, are
united by small striæ with the origin of the nerve of the
opposite side, forming a kind of commissure. From this
point of origin, the nerve makes its appearance with the
portio dura in an angle produced by the junction of the
medulla oblongata, pons Varolii, and crus cerebelli. The
portio dura is anterior, and in tracing it to its origin, will be
found to pass deeper than the origin of the portio mollis ;
and is separated from it by the thickness of the corpus res-
tiforme.

The two nerves proceed together, invested in a neurilema,
into the foramen auditorius internus—the portio mollis being
softer than the other cerebral nerves. In proportion as it
retires from the brain, the filaments become delicate, and so
interwoven with each other, as to form a complicated plexus.
At the under surface of the portio mollis, there is a round,
white, and distinct filament, which passes to the cochlea.
This filament is more compact than the others ; but it is with
difficulty that the fine lines, which mark its divisions into
minuter filaments, are discoverable.

The portio mollis distributes itself to the labyrinth of the
ear, by two rami : first, the above-mentioned to the cochlea—

(A.) *Ramus n. cochlearis.*—This enters the base of the cochlea, through a cribriform plate, at the inferior part of the bottom of the internal meatus, sometimes by a single large foramen in the centre of the modiolus, at others by three or more foramina, through which the ramus cochlearis distributes corresponding filaments, which ultimately ramify within the scalæ on the upper and under surface of the gyrus, first on its bony, and lastly on its membranous portion.

(B.) The *ramus n. vestibuli*—separates from the portio mollis within the auditory foramen, and distributes itself to the vestibule in three ramuli—a greater, a middle, and a lesser ramulus.

(a.) *Ramulus n. magnus*—enters the vestibule from the upper part of the meatus internus, into the anterior part of the cavity of the vestibule, and ramifies in two directions—one through a pyramidal cribriform plate of bone, which projects into the cavity of the vestibule, being distributed to the structures within the vestibule; the other passes to the outer side of the inner wall of the vestibule, and is distributed to the approximated ampullæ of the superior vertical, and horizontal semi-circular canals, in which it is lost.

(b.) *Ramulus n. medius*—is smaller than the preceding; it enters a separate cribriform plate below the former, in the inner wall of the vestibule, nearly opposite to the foramen ovale; it distributes itself to the cavity of the vestibule.

(c.) *Ramulus n. minimus*—enters a foramen in the posterior part of the internal meatus, which terminates in a cribriform plate, through which its minute filaments are distributed, partly to the ampullæ of the posterior vertical semi-circular canal, and partly to structures within the vestibule situated at the termination of the scala vestibuli.

(9.) *Glosso-pharyngeal*—arises from the tractus respiratorius of Sir Charles Bell, by three or four fine filaments, immediately beneath the facial, and above the pneumo-, gastric nerve; from the latter of which it is separated by a small portion of the pia mater of the fourth ventricle. These filaments unite and form a nervous cord, which is directed

outwards, towards the anterior part of the foramen lacerum basis cranii, through which it passes in front of the pneumo-gastric nerve—separated from it by a distinct foramen, formed of the dura mater.  As soon as it has passed out of the skull, it is placed to the inner side, as well as anterior to the pneumo-gastric nerve, and internal jugular vein ; and sends off—

(A.) *Ramus n. anastomoticus*—which penetrates the tym-panum by a canal placed by the side of the stylo-mastoid foramen, passes to the promontory, and unites with filaments of the videan nerve, and sympathetic filaments from the carotid canal.  It next sends—

(B.) *Rami n. communicantes*—to the par vagum and facial nerves, and receives filaments from the sympathetic.

The glosso-pharyngeal nerve then crosses between the external and internal carotid arteries, where it sends off two slender rami to be connected with the pharyngeal branch of the par vagum, and assists in forming the pharyngeal plexus —uniting in the course of the internal carotid artery, with filaments from the cardiac branches of the sympathetic nerve.

It next sends off filaments to the stylo-pharyngeus muscle, and then immediately two considerable rami, which are se-parated opposite to the styloid process of the temporal bone, they take their course inwards, and backwards, to the supe-rior and middle constrictors of the pharynx, on which they are distributed — supplying also the tonsil, and mucous membrane of the pharynx.   These branches, as well as those which go to the glosso-pharyngeus muscle, assist in forming the pharyngeal plexus, and may all be termed the *rami pharyngei*.

The glosso-pharyngeal nerve continues its course along the stylo-pharyngeus muscle, until it reaches the pharynx ; and then passing between the stylo-glossus, and hyo-glossus muscles reaches the tongue, and divides into three ter-minating rami.

(D.) *Ramus n. lingualis superior*—passes into the mus-

culus lingualis, and constrictor isthmi faucicum, the mucous
membrane and its follicles, and sends off—

(D.) *Ramulus n. tonsillaris*—which expends itself in the
tonsil, furnishing it with distinct filaments.

(E.) *Ramus n. lingualis inferior*—passes into the hyo-
glossus muscle, and to the mucous membrane reflected from
the under surface of the base of the tongue to the epiglottis
—supplying its mucous follicles.

(F.) *Ramus n. lingualis medius*—passes into the tongue
beneath the hyo-glossus muscle, then is directed to the
upper surface of the organ—supplying the mucous follicles
and papillæ capitatæ at the base of the tongue.

The glosso-pharyngeal nerve, is placed in the tongue,
above the lingual nerve, but below the ramusculus gusta-
torius of the third division of the fifth pair.

(10.) *Tenth pair—par vagum, or pneumo-gastric nerves.*
—These nerves arise immediately beneath the glosso-pha-
ryngeal, and above the accessory; which are all indeed
having origin from the same tract of spinal marrow, and from
which circumstance they might be considered as one nerve,
but that they are so differently distributed as to require a
separate description. The pneumo-gastric nerve, arises im-
mediately behind the corpus olivare, between it and the
corpus restiforme, by eight or ten filaments, from five to six
lines in length, and which are placed close to each other,
becoming immediately enveloped in a neurilema; they pre-
sent great firmness, and unite to form a broad flattened
cord, which is directed forwards and outwards, towards the
foramen lacerum basis cranii, through which it escapes from
the interior of the skull, being in its passage separated
from the jugular vein by a process of bone, and from the
glosso-pharyngeal nerve by a distinct process of dura
mater.

The precise position of the nerves which pass out of the
foramen lacerum basis cranii, with respect to the internal
jugular vein is, that they are anterior and internal to the
vein. Within the foramen lacerum, the pneumo-gastric

nerve becomes rounded, and the filaments forming the cord frequently unite, producing a kind of plexus, or sometimes even the appearance of a ganglionic enlargement, having a greyish tint; and it is here intimately connected with the spinal accessory, glosso-pharyngeal, hypo-glossal, and some filaments from the superior cervical ganglion of the sympathetic nerve. The pneumo-gastric nerve is, as it issues from the skull, placed in front of the hypo-glossal, but as it descends towards the neck, it soon becomes posterior to it; and they are entirely separated from each other, when they have descended as low as the transverse process of the atlas.

The par vagum then continues its course down the fore and lateral part of the neck, lying on the rectus capitus anticus major, and on the longus colli muscles, taking the same direction as the sympathetic nerve, but is separated from it by being enclosed in the carotid sheath, in which it is placed on the outer side of the carotid artery, between it and the internal jugular vein. The nerve next leaves the cervical region, and penetrates the chest by passing through its upper opening, behind the subclavian veins, on the right side in front of the subclavian artery, and on the left side before the arch of the aorta. When it has gained the thorax, it passes backwards, behind the bronchi; but soon leaves them, and passes forwards again towards the œsophagus, along which it passes, through the diaphragm, to supply the stomach, where it terminates. While the pneumo-gastric nerves are running along the œsophagus, that on the right side is placed much posterior to the left.

The rami which are sent off by the par vagum in this course, are—

(A.) *Rami n. communicantes.*—These have been already described as being sent off within the foramen lacerum basis cranii, and connecting the pneumo-gastric with the spinal accessory, the glosso-pharyngeal, the lingual, and with the sympathetic nerves.

Almost immediately after the par vagum has passed

through the foramen lacerum basis cranii, and has given off
its communicating branches, it sends off—

(B.) *Ramus n. pharyngeus*—which directly it is separated
from the par vagum, takes its course downwards and for-
wards, and is connected by a small branch with the spinal
accessory nerve; it then continues its course forwards, cross-
ing behind the internal carotid artery, to which it sends
ramusculi—uniting with filaments of the glosso-pharyngeal
nerve; it still continues forwards, and reaching the pha-
rynx, it divides into several filaments to supply the con-
strictors; and uniting with branches from the glosso-
pharyngeal, the superior laryngeal ramus of the par vagum,
and the superior cervical ganglion of the sympathetic nerve,
they together constitute what is termed the pharyngeal
plexus, from which emanate numerous filaments to supply
the three constrictors of the pharynx.

- (c.) *Ramus n. laryngeus superior*—is the next branch se-
parated from the pneumo-gastric nerve; it takes its course
downwards and inwards, and like the last-described branch,
passes behind the internal carotid artery, and to the outer
side of the superior cervical ganglion of the sympathetic,
with which it is connected by two or three filaments, as well
as with the hypo-glossal nerve; immediately after this junc-
tion with the sympathetic, it divides into two ramuli.

(*a*,) *Ramulus n. laryngeus externus*—which is the less im-
portant of the two, descends towards the sides of the larynx,
and distributes itself entirely to the muscles connected with
the larynx, as the sterno-hyoideus, sterno-thyroideus, thyro-
hyoideus, crico-thyroideus, and the middle constrictor of the
pharynx.

(*b*,) *Ramulus n. laryngeus internus*—directs itself inwards,
and to gain the larynx passes behind the thyro-hyoideus
muscle, penetrates the thyro-hyoideal ligament, and divides
itself into two sets of ramusculi.

(*a*.) *Ramusculi n. superiores*—distribute themselves to the
anterior surface of the epiglottis, the epiglottidean gland,
and to the mucous membrane of the pharynx.

(β.) *Ramusculi n. inferiores*—are larger than the superior, and are distributed to the mucous membranes of the larynx and pharynx, and to the arytenoid glands and muscles; one branch in particular, descending to supply the crico-thyroideus muscle.

Cloquet describes, that these filaments never supply the muscles which open the larynx, but they may always be traced to those muscles, and uniting with the filaments of the recurrent laryngeal nerve.

The pneumo-gastric nerve, after it has sent off this branch, continues its course down the neck within the carotid sheath, being connected with the cervical branch of the hypo-glossal nerve, with the first pair of cervical nerves, and with the superior cervical ganglion of the sympathetic, which together distribute small, delicate, soft filaments, to the internal carotid artery.

The par vagum reaching the lower part of the neck, sends off their cardiac branches, which are differently distributed on the two sides.

(D.) *Rami n. cardiaci.*—These branches on the right side are given off from the pneumo-gastric nerve, about an inch above the sterno-clavicular articulation; they descend obliquely outwards, in front of the arteria innominata, and are lost by uniting with the cardiac plexus from the inferior cervical ganglion of the sympathetic nerve.

The cardiac ramus on the left side, is generally but one branch, which runs along the corresponding carotid artery, and gaining the arch of the aorta, spreads upon it, and supplies the upper and posterior part of the heart.

(E.) *Ramus n. laryngeus inferior, vel recurrens*—is separated from the pneumo-gastric nerve, after it has passed into the thorax, and they differ a little with respect to each other on the right and left side. The left branch is given off a little lower down than the right, and in curving, to ascend, passes behind the arch of the aorta, while the right recurrent branch passes behind the right subclavian artery; thus they gain the neck, along which they ascend behind the common

carotid arteries and the inferior thyroideal ramuli a., by the sides of the trachea to the larynx, in which they terminate. In this course, the ramus n. laryngeus inferior gives off the following ramuli.

(a.) *Ramuli n. cardiaci*—are two or three twigs, which unite with the rami cardiaci from the pneumo-gastric nerve, and those from the inferior cervical ganglion of the sympathetic, which together form a plexus, and are distributed to the heart.

(b.) *Ramuli n. pulmonares*—are sent off higher up than the last-described, descend in front of the trachea, and taking the course of the corresponding pulmonary arteries, are lost in the lungs. The recurrent nerves, still proceeding upwards towards the larynx, supply in their course the œsophagus, the mucous membranes of the trachea, and the thyroid gland; and when they arrive at the larynx, they divide into several filaments to supply the inferior constrictor of the pharynx, and its mucous membrane; and others, which are distributed to the crico-arytenoidei postici, crico-arytenoidei laterales, and the thyro-arytenoidei muscles, as well as the mucous membrane of the larynx: these filaments form junctions with the superior laryngeal branches of the par vagum.

The pneumo-gastric nerves having given off the recurrent laryngeal rami, continue their course within the chest, and opposite the division of the trachea into the bronchi, send off three or four rami, termed the—

(F.) *Rami n. pulmonares*—which unite with filaments from the ramus laryngeus inferior, and the inferior cervical, and superior thoracic ganglia of the sympathetic—all of which concur in forming the *pulmonary plexus;* and from it are sent off numerous ramifications, which form a kind of net-work behind the roots of each lung, and distribute delicate filaments to the mucous membrane and follicles of the bronchi.

Below the pulmonary plexus, the filaments of the pneumo-gastric nerve re-unite and form again distinct cords, which descend along the œsophagus. The one on the right side is formed of three or four filaments, which are sent off from

the lower part of the pulmonary plexus; and before they ultimately unite, form on the right side, and posterior surface of the œsophagus, an intricate plexus, and then produce a single cord. On the left side, the œsophageal rami issue from the left pulmonary plexus, and proceed upon the anterior surface and left side of the œsophagus, at first being composed of two or three branches, which, as on the right side, ultimately unite ; both are distributed to the œsophagus, and also send filaments to the aorta. They then issue from the thorax, and enter the abdomen by the same opening as the œsophagus, along which they continue to pass, the right still remaining posterior, and the left anterior to that organ ; and when they reach the stomach, they both divide into numerous rami.

(H.) *Rami n. ventriculares*—which from the right nerve, pass to supply the posterior surface of the stomach, and penetrate its parietes, taking the course of the great curvature of the stomach, and terminate by being connected with the solar plexus of nerves, and assisting in forming the hepatic, splenic, and cæliac ganglia.

From the left, the ventricular rami take a longitudinal course along the less curvature of the stomach, extending as far as the pylorus, and supply by many branches, the anterior surface of the organ.

(11.) *Eleventh pair—hypo-glossal, or lingual nerves*— arise from the medulla oblongata, from the groove which separates the corpora pyramidalia, from the corpora olivaria, by several filaments which pass through the dura mater, and then unite to form a cord, which passes out of the cranium through the foramen condyloideum anticum. Immediately this nerve has passed through the anterior condyloid foramen, it becomes connected with the pneumo-gastric nerve, and then taking its course downwards, and forwards, passes over the external and internal carotid arteries, pneumo-gastric, and sympathetic nerves, and under the digastric and stylohyoides muscles, and the internal jugular vein ; it unites with the arch formed by the junction of the suboccipital and.

first pair of cervical nerves.   It then passes forwards towards the angle of the jaw, takes its course along the under edge of the tendon of the digastricus muscle, and then rises upwards towards the tongue.   Just where the lingual nerve forms its curve around the digastric muscle, it frequently receives a filament from the pneumo-gastric nerve, and immediately sends off the—

(A.) *Ramus n. cervicalis descendens.*—This branch descends along the inner side of the internal jugular vein, taking its course downwards, in the direction of the pneumo-gastric nerve, to about the middle of the neck, sending off two ramuli—

(a.) *Ramuli n. musculares*—which supply the omo-hyoideus and sterno-thyroideus muscles, and then is reflected backwards and upwards to unite behind the sterno-cleido mastoideus, with a descending branch from the second and third pair of the cervical nerves, forming an arch, from the convexity of which filaments are distributed, some passing forwards to supply the thyro-hyoideus, some downwards to the omo-hyoideus, and others outwards to the posterior edge of the sterno-cleido mastoideus, where they anastomose with filaments of the third and fourth cervical nerves.

(b.) *Ramulus n. lingualis*—is really the continuation of the nervous trunk, and takes its course forwards and upwards, passing between the venous rami of the internal jugular, and the external carotid ramulus; accompanying its corresponding artery between the mylo-hyoideus and hyo-glossus muscles, until it reaches the outer or posterior edge of the hyo-glossus; and then the arterial branch leaves the nerve by passing upon its upper or mucous surface; while between the mylo-hyoideus, and hyo-glossus muscles, the ramulus lingualis gives off—

(a.) *Ramusculi n. musculares*—to supply the thyro-hyoideus, constrictor pharyngeus superior, stylo-pharyngeus, genio-hyoideus, mylo-hyoideus, and genio-glossus muscles: it is also connected with the superior cervical ganglion of the sympathetic, and with the mylo-hyoideal filaments of

the ramusculus dentalis n. inferior. Upon the inferior, or
cutaneous surface of the hyo-glossus muscle, several junc-
tions take place, between the gustatory branch of the third
division of the fifth pair, and this lingual ramulus; which,
upon arriving at the anterior edge of the hyo-glossus, again
meets its corresponding arterial ramulus, and they together
pass between the genio-glossus, and lingualis muscles, and
then passing forwards and inwards, the ramulus n. lingualis
is lost by being distributed to the muscles of the tongue.

# LECTURE XXXIV.

THE spinal nerves consist of thirty-two pair, on either side arising from the sides of the medulla spinalis, and are named numerically, commencing from above, as first pair, second, third, and so on. There are two pair, however, which differ from the remainder of the spinal nerves; namely, the accessory—peculiar in arising from the spinal marrow low in the cervical region, passing into the cranium and then out again through the foramen lacerum basis cranii; and the sub-occipital—which takes origin from the spinal marrow, between the foramen magnum and the atlas. These two nerves, therefore, are usually described separately, and are not classed with the other spinal nerves; although the accessory only, does not correspond with the rest of the spinal nerves, in arising from the anterior and posterior pillars of the medulla spinalis by distinct roots.

(1.) *Nervus accessorius Willisii*—arises from the posterior part of the lateral surface of the spinal marrow, from the tractus respiratorius of Sir Charles Bell, by several filaments, which are placed between the posterior roots of the cervical nerves, and the ligamenta denticulata. It usually arises opposite to the fourth cervical nerve, but sometimes as low down as the sixth, or even the seventh. As the accessory nerve ascends, it increases in size, from the additional filaments which it receives, and enters the skull through the foramen magnum, posterior to the vertebral artery; in this passage not uniting with the sub-occipital nerve. Having

entered the foramen magnum, it is directed outwards, and a little forwards, to gain the foramen lacerum basis cranii, beneath the pneumo-gastric nerve, but enclosed in the same sheath, and firmly connected with it. On leaving the skull, in its passage through the lacerated foramen it becomes connected with the hypo-glossus nerve, then leaves it, passes outwards behind the internal jugular vein to gain the sterno-cleido mastoideus muscle, which it penetrates, and terminates by distributing branches to the trapezius muscle. In this course, it sends off the following rami.

(A.) *Ramus n. communicans.*—This branch is sent off from the accessory, while enclosed within the same sheath with the pneumo-gastric nerve, to which it passes, hence it is named the accessory nerve to the par vagum, which is enlarged in consequence of this addition.

(B.) *Ramus n. pharyngeus accessorius*—is a small branch generally divided into one or two filaments, which become immediately connected with the ramus pharyngeus of the par vagum, as well as some filaments of the superior cervical ganglion of the sympathetic, these together forming the pharyngeal plexus. This branch then continues beneath the ramus laryngeus superior, and divides into several filaments, producing a plexiform appearance by its frequent connection with the pneumo-gastric nerve.

(2.) *Nervi sub-occipitales*—arise from the spinal marrow immediately below the medulla oblongata, between the occiput and the atlas; like all the other spinal nerves each nerve arises by anterior and posterior filaments, the latter forming a ganglion; the two roots of the nerve converge, pass outwards and backwards to perforate the fibrous canal, by which the vertebral artery enters the skull; and then the two roots unite to form one nerve, from which there emanate two rami.

(A.) *Ramus n. anterior*—is small, directs itself from behind forwards, over the transverse processes of the atlas, in front of which it descends to be united with the first pair of cervical nerves, producing an arch which embraces the

transverse process of the atlas. The ramus anterior, in its course sends off—

(*a.*) *Ramuli n. musculares*—which divide themselves into several small ramusculi, to supply the rectus capitis lateralis, rectus capitis anterior minor muscles, and also send off communicating ramusculi to the superior cervical ganglion of the sympathetic, pneumo-gastric, and hypo-glossal nerves.

(B.) *Ramus n. posterior*—is larger, but shorter than the ramus anterior; it takes its course upwards, and backwards, towards a space between the obliqui, and rectus capitis posticus major muscles, having gained which it divides into three ramuli.

(*a.*) *Ramulus n. occipitalis superior et internus.*—This ramulus is directed upwards and inwards, between the complexus and the rectus capitis posticus major, and minor muscles, to each of which it distributes filaments.

(*b.*) *Ramulus n. occipitalis superior, et externus*—passes outwards, and is lost upon the obliquus capitis superior muscle.

(*c.*) *Ramulus n. occipitalis inferior, vel cervicalis*—descends towards the obliquus inferior muscle, to which it distributes branches; and then dividing into filaments, it unites with the posterior branch of the first cervical nerve, and sends a few filaments to the complexus muscle. The sub-occipital nerve, is described by some anatomists as the first pair of cervical; but as it does not reach the spinal foramen of the cervical vertebræ, it appears more adviseable to describe it separate from the cervical nerves.

### Nervi Cervicales.

The cervical nerves consist of seven pairs, of which the following general description may be first given. They are all sent off from the spinal marrow, arising by two distinct roots; they pass out of the vertebral foramina, bounded posteriorly, by the scalenus medius muscle; and anteriorly, the three upper are bounded by the rectus capitis anticus major, and the four lower, by the longus colli muscle.

The three superior pairs are all alike in being connected with each other, with the superior and middle cervical ganglia of the sympathetic, with the pneumo-gastric, and hypo-glossal nerves, as well as in supplying the exterior of the back of the head, and the neck.

The three lower pairs all unite with each other, and with the first dorsal pair, to form the axillary plexus; while the fourth or middle cervical pair, assist both the upper and the lower set in performing their particular functions. Besides this description, each of the cervical nerves sends off some rami peculiar to itself, requiring therefore a separate, and particular description.

(3.) *Nervi cervicales primi*—pass out of the spinal canal, between the atlas and vertebra dentata, and divide into an anterior and posterior ramus.

(A.) *Ramus n. anterior*—passes forwards between the transverse processes of the first two vertebræ, and divides into—

(a.) *Ramulus n. ascendens*—which sub-divides into two or three ramusculi, one of which unites with the sub-occipital nerve, another with the superior cervical ganglion of the sympathetic, a third with the pneumo-gastric; and it terminates by sending some small branches to the rectus capitis anticus major muscle.

(b.) *Ramulus n. descendens*—passes downwards to be connected with the second pair of cervical nerves.

(B.) *Ramus n. posterior, vel occipitalis magnus*—is a larger branch than the anterior, from which circumstance it differs from all the other cervical nerves. At its commencement it unites, above, with the sub-occipital nerve, and below, with the posterior branch of the second cervical pair; it then continues its course, passing from below upwards and backwards, on the inferior oblique muscle, ascending between it and the complexus muscle, which it traverses; becoming then subcutaneous, it divides into numerous ramuli.

(a.) *Ramuli n. musculares*—these supply the complexus,

trachelo-mastoideus, splenius, and trapezius muscles, and terminate at the back of the head, in filaments, which expand upon the occipital muscles and the integuments; uniting with filaments of the sub-occipital, and facial nerves.

(4.) *Nervi cervicales secundi*—pass out between the second and third cervical vertebræ, are larger than the preceding, and like them, divide into an anterior, and posterior ramus.

(A.) *Ramus n. anterior*—passes forwards and outwards, and subdivides into—

(a.) *Ramulus n. ascendens*—which unites with the first pair, and

(b.) *Ramulus n. descendens*—to unite with the third pair of cervical nerves; it receives also a filament from the superior cervical ganglion, and a second from the sympathetic nerve itself, in its course downwards towards the middle cervical ganglion; each filament concurring in forming the cervical plexus. The ramulus descendens then terminates by supplying the rectus capitis antieus major, and the levator anguli scapulæ muscles.

(B.) *Ramus n. posterior*—is smaller than the anterior branch, is directed backwards, around the articulation between the second and third cervical vertebræ, and becomes subcutaneous at the upper part of the neck. It sends a filament to unite with the posterior branch of the first pair, and then divides into a number of ramuli, which distribute themselves to the recti and oblique muscles of the head, to the cervical, inter-spinous muscles, trachelo mastoideus, splenius, and transversalis muscle, and terminates by ramifying on the integuments of the back part of the head and neck.

(5.) *Nervi cervicales tertii*—emanate from the spinal marrow, between the third and fourth cervical vertebræ; they are smaller than the last pair, and each divides into an anterior and a posterior branch.

(A.) *Ramus n. anterior* — passes forwards, and sends a ramulus upwards to unite with the second pair, and a

ramulus downwards to unite with the fourth pair; it also receives a filament from the superior cervical ganglion.of the sympathetic; all uniting to form the cervical plexus.

(B.) *Ramus n. posterior*—is placed in a groove formed between the articular processes of the third and fourth cervical vertebræ, from which it emanates, and descends between the complexus and semi-spinalis colli muscles, to both of which it sends filaments, and is ultimately lost upon the skin of the back.

The *plexus cervicalis.*—It has already been described, that the anterior branches of the first, second, and third pair of cervical nerves, after receiving filaments from the superior cervical ganglion of the sympathetic, unite with each other, forming arches, which send off branches. that again unite, producing the cervical plexus.

This plexus is situated on the sides of the neck, in the space between the second, third, and fourth vertebræ. It is bounded on the inner side by the scalenus medius, the pneumo-gastric nerve, the carotid artery, and the jugular vein; and outwards, by the sterno-cleido mastoideus; it communicates above with the sub-occipital nerves, below, with the brachial plexus, inwards, with the ganglia of the sympathetic—furnishing also branches of connection with the spinal accessory nerve; and terminating .by numerous rami, which may be classified into ascending and descending branches.

(A.) *Ramus n. descendens internus*—arises by two filaments from the second and third pair of cervical nerves, and unites to form a single cord, which descends behind the sterno-cleido mastoideus, and in the middle of the neck unites with the ramus n. cervicalis descendens of the hypo-glossal nerve, forming loops or arches upon the inner side of the sterno-cleido mastoideus.

(B.) *Ramus n. diaphragmaticus, vel phrenicus.*—This branch, as well as the former, is frequently described as. distinctly arising from the cervical nerves themselves; but evidently they spring from the plexus. The filaments, however,

which form it, may be traced principally to the anterior branch of the third pair of cervical nerves; also some may be traced to the fourth, and to the second pairs. It then descends along the side of the neck, receiving filaments from the brachial plexus at the lower part of the neck, and uniting with the descending cervical branch of the hypo-glossal nerve, and the superior cervical ganglion of the sympathetic. In its passage down upon the neck, it is placed between the rectus capitis anticus major, and sca-lenus anticus muscles, upon the latter of which it becomes placed more inferiorly—communicating here with the inferior cervical ganglion of the sympathetic by one or two fila-ments; it then penetrates the chest, in front of the sub-clavian arterial ramus, and behind the corresponding vein. It is then found in the middle mediastinum, between the pleura and the pericardium, descending towards the dia-phragm.

The phrenic nerve of the right side, which is placed more vertically and anteriorly than the left, divides before entering the diaphragm, into six or seven ramuli; some of which are distributed to that muscle, and others pass through it, accompanying the corresponding arterial and venous ra-muli, to supply the under surface of the diaphragm, and unite with the cæliac plexus of the pneumo-gastric nerve. . The left phrenic nerve is posterior to the preceding, is more ob-lique in its course, being turned to the left by the apex of the heart; it is distributed to the two surfaces of the dia-phragm, and sends some filaments to the œsophagus, and ultimately unites with the solar, and cæliac plexus.

(c.) *Rami n. descendentes externi*—arise principally from the third and fourth pairs of cervical nerves, by filaments which produce numerous ramuli, which afterwards sub-divide, and are named according to the direction which they take.

(a.) *Ramuli n. supra-claviculares*—these descend under the platysma myoides muscle, divide into a number of fila-ments, some of which pass in front of the clavicle to be

s

distributed to the pectoralis major muscle, the integuments of the thorax, and to the mammæ, while others pass more outwards, and are lost upon the skin, and muscles of the shoulder.

(*b.*) *Ramuli n. supra-acromiales*—take their course along the upper edge of the trapezius muscle, which they in part supply, and unite with filaments of the spinal accessory nerve, terminating in filaments which are lost in the upper part of the acromion.

(*c.*) *Ramuli n. sub-claviculares*—pass deeply seated in the cellular membrane, between the sterno-cleido mastoideus and the trapezius, then pass behind the clavicle to be distributed to the omo hyoideus, serratus magnus, and subscapularis muscles, and cellular membrane within the axilla.

(*d.*) *Ramuli n. cervicales profundi*—pass downwards, backwards, and outwards, accompanying and uniting with the descending branches of the spinal accessory nerve, to be distributed to the trapezius, levator scapulæ, and rhomboidei muscles.

The first of the ascending branches from the cervical plexus, is—

(*a.*) *Ramulus n. superficialis colli* — arises principally from those filaments of the cervical plexus, which proceed from the second pair of cervical nerves; it bends around the posterior edge of the sterno-cleido mastoideus, and divides into numerous ramuli—many of which terminate upon the skin, side of the neck, and the lower jaw—uniting with filaments of the facial nerve.

(*b.*) *Ramulus n. auricularis*—sometimes arises from the preceding ramulus, at others separately from the cervical plexus; it is directed upwards to the anterior edge of the sterno-cleido mastoideus, along which it ascends to the angle of the lower jaw, where it divides into several ramusculi, the anterior of which ascend upon the outer surface of the parotid gland, uniting with the facial nerve, and are lost in the integuments of the ear; while the posterior ramusculi take their course upwards, upon the mastoid

process of the temporal bone, expand themselves upon the
ear, and the integuments covering the meatus auditorius
externus, and the sides of the head.

(c.) *Ramulus n. occipitalis minor*—usually arises sepa-
rately from the cervical plexus, passes upwards over the
splenius and trachelo mastoideus muscles, towards the mas-
toid process of the temporal bone, where it divides into
numerous filaments to be distributed to the occiput and back
part of the ear, and to unite with the facial, and posterior
branch of the second cervical nerves.

(6.) *Nervi cervicales quarti.*—This pair of nerves has
already been described as forming the phrenic nerve and the
cervical plexus; but it is also united with the—

*Fifth, sixth, and seventh pairs,* to form the *axillary
plexus.*

The *anterior branches* of these nerves are very large, and
pass out upon the lateral region of the neck, between the
scalenus medius and scalenus anticus muscles, where they
furnish one or two small filaments, which unite with the
middle and inferior cervical ganglia of the sympathetic
nerve; they then all unite to produce the axillary plexus.

The anterior branch of the fourth pair of cervical nerves,
unites above with the third pair; and the anterior branch
of the seventh, below, with the first pair of dorsal nerves.

The *posterior branches* of the fourth, fifth, sixth and
seventh pairs of cervical nerves, are much smaller than the
anterior, and pass obliquely outwards, between the semi-
spinalis colli and complexus muscles, supplying them with
filaments, as well as the splenius and trapezius muscles, and
are then lost upon the integuments, and posterior part of
the back, and neck.

### Plexus Axillaris.

The axillary plexus formed by the anterior branches of
the nerves above named, and of the anterior branch of the
first dorsal, is large above and below, and contracted in
its centre, reaching from the lateral and inferior part of the

neck, into the axilla. At its origin, it passes out between
the two scaleni muscles, is directed downwards, between the
subclavius muscle and the first rib, rests upon the serratus
magnus muscle, surrounding the subclavian artery and the
vein, and then divides into numerous branches. This plexus
may be divided into thirds ; the superior of which is above
and to the outer side of the subclavian artery, the middle
completely surrounding it, and the inferior third divides
into numerous branches, which are placed in a regular order
on either side of the vessel. The branches given off from
the axillary plexus, are—

(A.) *Rami n. thoracici.*—The filaments forming these
nerves, are sent off principally from the cervical nerves,
between the fourth and sixth, and are given off from the
anterior and posterior parts of the plexus, so as to be dis-
tinctly divided into an anterior and posterior ramulus.

(a.) *Ramulus n. anterior.*—The filaments which form this
ramulus, are derived from the sixth pair of cervical nerves,
and unite in a cord, which passes behind the clavicle, where
it divides into numerous ramusculi, which pass in front of
the axillary artery, and in part surround it. The ramusculi
then descend upon the thorax, and are distributed to the
pectorales muscles.

(b.) *Ramulus n. posterior*—is principally derived from the
fourth and fifth pairs of cervical nerves. It descends upon
the parietes of the chest, to be distributed to the serratus
magnus muscle ; at the lower part of which it divides into
numerous ramusculi.

(B.) *Ramus n. suprascapularis*—springs principally from
the fourth pair of cervical nerves ; usually, however, deriving
a small filament from the fifth pair. It descends obliquely
backwards, behind the trapezius muscle, accompanying the
ramulus a. supra-scapularis, towards the superior part of
the shoulder, where it reaches the proper notch of the
scapula ; and here it separates from the arterial ramulus to
pass through the foramen under the ligament, while the
artery passes over it. The first ramusculus which this ramus

gives off, supplies the subscapularis muscle. It afterwards furnishes numerous filaments, which are lost upon the supra and infra spinati muscles, and the teres minor.

(c.) *Rami n. infra-scapulares*—these are so variable in number, origin, and distribution, as generally not to be described as distinct branches; but still from their size are sufficiently important. Most frequently, they are three in number; the first passes to supply the serratus magnus, and the subscapularis muscles, and is ultimately lost upon the latissimus dorsi; this ramus passes behind the axillary artery, to gain the muscles which it supplies: the second branch, is lost entirely in the subscapularis muscle: while the third passes downwards and backwards, along the anterior edge of the subscapularis muscle, and is lost in the terretes.

(D.) *Ramus n. articularis, vel circumflexus*—arises from filaments of the sixth and seventh cervical, and first pair of dorsal nerves; it descends in front of the subscapularis muscle, to which it distributes a ramulus; it then takes its course from before backwards, between the terretes muscles and the long head of the triceps, and gains the posterior and superior part of the humerus, sending some small filaments to those muscles; it continues its course from within outwards, gains the posterior edge of the deltoid muscle, passes between it and the humerus, and terminates by supplying the posterior part of the deltoid, and the capsular ligament of the shoulder-joint.

(E.) *Ramus n. cutaneus internus*—arises by small filaments, from the last cervical, and first dorsal pair of nerves. It descends vertically along the inner side of the arm, taking the course of the ramus venosus basilicus, distributing unimportant filaments to the skin in its descent; but just before it arrives at the inner condyle of the humerus, it divides into two ramuli.

(a.) *Ramulus n. externus*—is the smaller of the two, takes its course along the biceps muscle, penetrates the brachial aponeurosis to accompany the median nerve to the bend of the elbow; where it again becomes sub-cutaneous,

and divides into several filaments, some of which descend with the integuments as low as the wrist.

(b.) *Ramulus n. internus*—descends upon the brachialis internus muscle, and just at the inner condyle divides into an anterior and posterior ramusculus, which supply the skin on the anterior and posterior side of the fore arm, as low as the wrist-joint, taking the course of, and surrounding the subcutaneous veins on the inner side of the arm.

(F.) *Ramus n. cutaneus internus minor*—is by some anatomists described as a branch of the ulnar nerve, but it may generally be traced distinctly from the axillary plexus itself; it is much smaller than the last-described nerve, and is partly lost upon the triceps muscle; but some of its filaments pass through the brachial aponeurosis, become subcutaneous, and are lost upon the skin on the inner side of the arm and axilla.

(G.) *Ramus n. cutaneus externus, vel musculo-cutaneus* —arises from the fourth and fifth pair of cervical nerves. It is larger than the last-described, and takes its course downwards and outwards, perforating the coraco-brachialis muscle, to which it distributes filaments; it then descends between the brachialis internus, and the biceps muscles, distributing filaments to each of them, and uniting with the median nerve; it continues its course along the outer side of the tendon of the biceps, between it and the superior radii longus, passes through the bend of the elbow, crossing behind the median cephalic vein; it then descends along the fore and outer part of the arm, between the aponeurosis and the skin, and just before it reaches the wrist-joint, it divides into an outer, and an inner ramulus.

(a.) *Ramulus n. posterior*—is the larger of the two, passes outwards to the back of the hand, and sends a branch which passes to the fingers; it then descends behind the thumb, sending a filament to its radial side, and also to the fore finger.

(b.) *Ramulus n. anterior*—continues in the course of the principal ramus to the palm of the hand, divides into numer-

ous ramusculi to supply the muscles of the thumb and skin, covering them and the palm of the hand.

(H.) *Ramus n. medianus*—is the largest of all the nerves from the axillary plexus; it arises by filaments from all the cervical, and first pair of dorsal nerves; its origin is placed behind the internal cutaneus, and between the ulnar and external cutaneous nerves. These filaments unite into a nervous cord, which descends outwards, behind the biceps and on the inner side of the brachial artery; it continues its course with the artery through the bend of the elbow, on the inner side of the biceps, and passes between the two origins of the pronator radii teres; it then proceeds along the fore-arm, lying upon the flexor profundus digitorum, and being covered by the flexor sublimis; as it gains the wrist, the median nerve passes immediately behind the tendon of the palmaris longus muscle, and continuing under the ligamentum carpi annulare, gains the palm of the hand, where it divides into numerous digital ramuli. But in this course, it first gives off—

(a.) *Ramuli n. musculares*—which are distributed to the pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, the flexor digitorum sublimis et profundus, and the flexor longus pollicis. Almost immediately after, the median nerve sends off—

(b.) *Ramulus n. interosseus.*—This ramulus passes backwards between the flexor muscles of the fingers, to gain the anterior surface of the interosseous ligament; in its passage between the flexor muscles, it sends a ramusculus to the flexor sublimus digitorum; and secondly, ramusculi to the flexor profundus digitorum, and the flexor tertii internodii pollicis; it then accompanies the ramusculus arteriosus interosseus anterior, as far as the upper edge of the pronator quadratus muscle, where it divides into two sets of filaments, —the anterior of which are lost upon the anterior part of the wrist-joint, behind the pronator quadratus muscle; while the posterior penetrate the interosseous ligament, and are lost upon the back of the hand.

The ramus n. medianus—after having sent off the ramulus interosseus, continues its course downwards on the fore-arm, sending off muscular ramuli to the flexors of the fingers and wrist, forming also unions with the ulnar nerve; and about two inches above the ligamentum carpi annulare, it sends off—

(c.) *Ramulus n. palmaris cutaneus*—which is distributed, as its name would imply, to the skin of the palm of the hand, by passing between the tendons of the flexor sublimis, and thus becomes sub-cutaneous.

The ramus medianus having gained the hand, almost immediately divides itself into four or five distinct ramuli, which are ultimately distributed to the fingers; supplying, however, at the same time, the short muscles of the palm of the hand.

(d.) *Ramulus n. digitalis primus*—sends several fila-ments to the abductor, flexor primi, et secundi, internodii pollicis, and descends along the radial side of the thumb, as far as its extremity, accompanying the corresponding arterial ramification.

(e.) *Ramulus n. digitalis secundus*—descends upon the ulnar side of the thumb, and sends off numerous branches to supply the muscles and skin.

(f.) *Ramulus n. digitalis tertius* — descends upon the radial side of the metacarpal bone of the fore finger, sends a filament to the first lumbricalis muscle, and ultimately terminates by supplying the skin of the radial side of the fore finger.

(g.) *Ramulus n. digitalis quartus* — descends between the metacarpal bones of the fore and middle fingers, sup-plies the lumbricalis muscle in that situation, and at the anterior extremity of the metacarpal bone, it divides into two ramusculi, to supply the ulnar side of the fore, and the radial side of the middle finger.

(h.) *Ramulus n. digitalis quintus*—takes its course be-tween the metacarpal bones of the middle and ring fingers, supplies the corresponding lumbricalis muscle, divides into

two ramusculi, which expend themselves upon the ulnar
side of the middle finger, and the radial side of the little
finger. The latter ramusculus unites with the digital ramus-
culus of the ramus nervosus ulnaris.

(1.) *Ramus n. ulnaris, vel cubitalis*—is somewhat smaller
than the last branch, and is given off from the sixth and
seventh cervical, and first dorsal pair of nerves; it takes its
course downwards upon the inner side of the arm, resting
upon the triceps extensor cubiti muscle, and in this course
sends ramuli to it, as well as to the skin. It then passes
behind the internal condyle, between it and the olecranon
process of the ulna, and usually between the two origins of
the flexor carpi ulnaris, where it sends off a cutaneous branch
which takes the course of the superficial ulnar veins; it then
gains the fore-arm, passes obliquely downwards and for-
wards, on its inner side, between the flexor carpi ulnaris and
flexor digitorum profundus, and to the ulnar side of its
corresponding arterial ramus. It diminishes in size as it
descends, and divides just before it reaches the wrist-joint,
into two ramuli; previous to which, it furnishes muscular
ramuli, especially to the flexor carpi ulnaris, and flexor pro-
fundus digitorum.

(*a.*) *Ramulus n. palmaris*—takes its course along the radial
side of the flexor carpi ulnaris, passes upon the same side of
the pisiform bone, upon the anterior surface of the liga-
mentum carpi annulare, where it is connected with some of
the filaments of the median nerve, and then divides into two
ramusculi.

(*α.*) *Ramusculus n. profundus*—takes its course back-
wards, between the abductor and flexor brevis minimi digiti;
it is then directed outwards, behind the tendons of the flexors
of the fingers and the lumbricales, where it forms an arch
furnishing filaments from its convexity, to supply the muscles
of the little finger, and the interossii, as well as the adductor
muscle of the thumb, and abductor of the index finger.

(*β.*) *Ramusculus n. superficialis*—is connected by one or
two twigs, to filaments of the ramus n. medianus; it also

distributes filaments to the muscles of the little finger, and then divides into an outer and an inner ramification; the outer unites with the median nerve, supplies the fourth lumbricalis muscle, and terminates by two digital filaments which supply the ulnar side of the ring finger, and the radial side of the little finger; while the inner ramification, which is the smaller of the two, supplies the abductor minimi digiti, and is lost upon the ulnar side of the little finger.

(*b.*) *Ramulus n. dorsalis*—has already been described, as being separated from the ramus n. ulnaris above the wrist-joint; it is smaller than the palmar branch, and passes backwards, between the ulnar and the tendon of the flexor carpi ulnaris, to gain the back of the hand, where it divides into two ramusculi.

(*α.*) *Ramusculus n. internus*—descends along the ulnar side of the metacarpal bone and phalanges of the little finger, and is distributed to the skin upon their posterior surfaces.

(*β.*) *Ramusculus n. externus*—passes between the metacarpal bone of the ring, and middle fingers, and divides into two digital filaments, to be distributed to the radial side of the posterior surface of the middle finger, and ulnar side of the ring finger.

(κ.) *Ramus n. radialis, vel spiralis*—arises principally from the sixth and seventh cervical, and first dorsal pair of nerves; but filaments may generally be traced connected with all the nerves which enter into the composition of the axillary plexus; immediately after these filaments have united to form one ramus, it passes downwards and backwards, taking its course outwards in a spiral direction, between the humerus and the first and second heads of the triceps: and having gained the outer side of the arm, it descends between the brachialis internus, and extensores carpi radiales, to gain the elbow-joint, being placed posterior to the ramus n. cutaneus externus; and here it divides into two ramuli. In its course from its origin to the elbow, and before it divides into its two terminating ramuli, it first gives off—

(a.) *Ramuli n. musculares*—which supply the latissimus dorsi, and triceps muscles.

(b.) *Ramulus n. cutaneus posterior*—which pierces the brachial aponeurosis, and supplies the skin of the posterior parts of the arm and fore-arm; just before it divides, it sends off several filaments to supply the muscles about the elbow-joint, and usually a cutaneous filament, which supplies the skin on the outer side of the fore-arm.

(c.) *Ramulus n. anterior, vel superficialis*—descends into the fore-arm, along the ulnar side of the supinator radii longus, and on the radial side of the ramus arteriosus radialis; in the lower third of the fore-arm, it is directed outwards, passing between the radius, and tendon of the supinator radii longus, to gain the posterior surface of the bone, upon which it descends, lying superficial to the tendons of the extensors of the thumb, and then divides into two ramusculi.

(α.) *Ramusculus n. externus*—passes on the dorsal surface of the thumb, divides into two filaments, the outer of which is distributed to both sides of the thumb, and radial side of the fore finger; while—

(β.) *Ramusculus n. internus*—passes over the back of the hand, and is distributed upon the inner side of the dorsal surface of the index, and radial side of the middle finger.

(d.) *Ramulus n. posterior*—is separated from the ramus n. radialis, behind the supinator radii longus, to which it sends filaments, as well as to the extensores carpi radiales, and to the anconeus muscles. The ramulus n. posterior then perforates the supinator radii brevis muscle, to which it sends filaments; it then winds around the upper part of the radius, to gain the posterior part of the arm, and there divides into numerous ramusculi, which take an anterior and a posterior direction.

(α.) *Ramusculi n. posteriores*—are distributed to the extensor carpi ulnaris, the extensor longus digitorum, and the extensor indicis muscles; while—

(β.) *Ramusculi n. anteriores*—pass forwards to be distri-

buted to the muscles deeply seated between the radius and
ulna behind. One ramusculus in particular, descends along
the interosseous ligament, behind the ligamentum carpi an-
nulare dorsale, to be distributed on the back of the hand.

### Nervi Dorsales.

These nerves consist of twelve pairs, and are comparatively
smaller than the cervical nerves. They are named according
to their succession, beginning from above; they arise, like
the cervical nerves, by anterior and posterior roots from the
anterior and posterior columns of the spinal marrow; and
like them, unite into a single nerve as soon as they have
emerged from the intervertebral foramen. The first pair
pass out between the first two vertebræ of the back, the
last pair, between the last vertebra of the back and the first
of the loins.

(A.) The *rami n. posteriores*—of all the dorsal nerves, are
so alike in their distribution, as to admit of a general de-
scription. They pass backwards, between the transverse
processes of the dorsal vertebræ, under the semi-spinalis
dorsi, and multifidi spinæ; and then divide into two sets of
ramuli.

(a.) *Ramuli n. interni*—pass backwards and inwards,
through the spinalis dorsi, and multifidi spinæ muscles, im-
parting filaments to them, as well as to all the muscles of
the back, and are lost in supplying the skin.

(b.) *Ramuli n. externi*—are the larger, and pass out-
wards, beneath the deep layer of the muscles of the back,
and become superficial after passing between the sacro-
lumbalis and latissimus dorsi, to which they send ramusculi,
and are ultimately lost in the skin of the back and side.

(B.) *Rami n. anteriores*—each of these receives a fila-
ment from the thoracic ganglia of the sympathetic nerve;
then they pass outwards behind the pleura and between the
ribs, as far as the angle of those bones, when they enter
between the external and the internal layer of intercostal
muscles, passing with such an obliquity upwards, as to gain

the inferior edge of the rib above them; in which course, they are accompanied by the arteriæ intercostales.

The above general description refers to the whole of the dorsal nerves; but it will be now necessary to take a more particular view of the distribution of the anterior branch of each pair.

(10.) *Nervi dorsales primi.*

(B.) *Ramus n. anterior.*—One ramulus of this ramus has already been mentioned, as concurring in the formation of the axillary plexus; but it also sends off—

(b.) *Ramulus n. descendens*—which proceeds under the inferior surface of the first rib, passing inwards towards the sternum, perforates the intercostal muscles, and is lost upon the upper part of the chest.

(11.) *Nervi dorsales secundi.*

(B.) *Ramus n. anterior*—takes its course along the inner surface of the second rib, giving filaments to the intercostal, and the serratus magnus muscles, and then divides into—

(a.) *Ramulus n. intercostalis*—which continues to run along the lower edge of the rib, as far as the sternum, where it penetrates the external intercostal muscle, and is lost upon the chest.

(b.) *Ramulus n. brachialis*—perforates the external intercostal muscle, passes through the axilla, descends along the internal and posterior part of the arm, and near the elbow is lost by supplying the skin; uniting in its course with ramifications of the internal cutaneous nerve.

(12.) *Nervi dorsales tertii.*

(B.) *Ramus n. anterior.*—This ramus is distributed in a similar manner to the last, by being divided into two ramuli.

(a.) *Ramulus n. intercostalis*—takes the course of the rib, passes forwards to the sternum, supplies the intercostalis, and triangularis sterni muscles, perforates the external intercostal muscle, and is lost upon the anterior part of the chest.

(b.) *Ramulus n. brachialis*—also perforates the intercostal

muscle, which it supplies, crosses the lower part of the axilla, and is lost upon the inner side of the arm.

(13 to 17.) *Nervi dorsales*—4th, 5th, 6th, 7th.

(B.) *Rami n. anteriores*—take their course along the inferior edge of their corresponding ribs, and towards the centres divide into two ramuli.

(*a.*) *Ramuli n. interni*—continue in the course of their original branches, and distribute filaments about the sternum, to the triangularis sterni, pectoralis major muscles, mammæ, and integuments of the chest.

(*b.*) *Ramuli n. externi*—perforate the intercostal muscles, and supply by numerous filaments the integuments of the side of the chest, the obliquus abdominis externus muscle, and the integuments of the abdomen.

(18 to 20.) *Nervi dorsales*—8th, 9th, 10th, 11th.

(B.) *Rami n. anteriores*—take their course, and are distributed in a similar manner to the preceding rami of the upper dorsal nerves.

(*a.*) *Ramuli n. interni*—run along the inferior edge of their corresponding ribs, and gain the parietes of the abdomen by passing over the origins of the diaphragm; and being placed between the transversalis and obliquus abdominis internus muscles, to which they distribute filaments, then arrive at the outer edge of the rectus muscle, and there divide into two sets of ramusculi.

(*α.*) *Ramusculi n. profundi*—form the posterior distribution from the above, and supply the recti muscles only.

(*β.*) *Ramusculi n. superficiales*—penetrate these muscles, and are lost upon the integuments of the anterior region of the abdomen.

(*b.*) *Ramuli n. externi*—penetrate the intercostal muscles, and divide into filaments, which are distributed to the integuments of the lateral parts of the chest, and the muscles and skin of the abdomen.

(21.) *Nervi dorsales*—12th.

(B.) *Rami n. anteriores.*—Each of these, immediately at its origin, sends off—

(*a.*) *Ramulus n. communicans*—by which it is connected with the first lumbar nerve; the anterior branch is then directed downwards and outwards, passing in front of the quadratus lumborum muscle, and behind the fascia iliaca and fascia transversalis, takes the direction of the last rib, at the anterior extremity of which it divides into two ramusculi; the most superficial one passes between the obliqui muscles of the abdomen, distributes filaments to them, and is ultimately lost on the skin; the deeper one passes between the transversalis and internal oblique muscles, and terminates at the rectus and pyramidalis muscles.

### Nervi Lumbales.

These are five pairs, which arise from the inferior enlargement of the spinal marrow, by anterior and posterior branches, like all the other spinal nerves. The filaments that compose them are large and broad, especially of the three lower. These nerves are immediately enveloped in a neurilema, and pass downwards with such a degree of obliquity, and so separate from each other, as to form what has been termed the *cauda equina*. The posterior root of each of these nerves, like those of the dorsal region, form a ganglion; after which, the anterior and posterior filaments unite to produce one cord, which almost immediately divides into a posterior and an anterior branch.

(22.) *Nervi lumbales primi.*

(A.) *Ramus n. posterior*—is directed immediately backwards, between the transverse processes of the two first lumbar vertebræ, penetrates the lumbar mass of muscles, to which it distributes ramifications, and is lost by supplying the skin of the hip and gluteal region.

(B.) *Ramus n. anterior.*—This branch directly it has emerged from the intervertebral foramen, receives a branch from the lumbar ganglia of the sympathetic nerve, and also a communicating ramulus from the twelfth dorsal nerves. It then passes forwards and downwards, under the psoas muscle,

unites with the second lumbar nerve, and terminates by forming the lumbar plexus.

(23 to 26.) *Nervi lumbales*—2nd, 3rd, 4th, 5th.

These four pairs of lumbar nerves, divide into anterior and posterior branches, which are distributed in a similar manner to those of the first pair, differing only in situation; and like them also, they are connected with the sympathetic nerve, and with each other; and all concur in forming the—

### Plexus Lumbalis.

This plexus is produced by the union of ramuli from the anterior rami of the five pairs of lumbar nerves. It is deeply seated by the sides of the lumbar vertebræ, being covered by the psoas magnus muscle.

It is connected above, with the dorsal nerves, below, with the sacral plexus, and distributes the following rami.

(A.) *Ramus n. spermaticus externus*—arises from the first lumbar nerve, passes through the substance of the psoas muscle, and in its course receives a branch from the second lumbar nerve, by which it is increased in size, gains the anterior surface of the psoas muscle, and then divides into two ramuli.

(*a.*) *Ramulus n. internus*—takes the course of the spermatic cord, passing with it through the internal abdominal ring, inguinal canal, external ring, and is lost upon the integuments of the scrotum, and the superior and inner part of the thigh.

(*b.*) *Ramulus n. externus*—passes underneath Poupart's ligament with the femoral vessels, and there divides into numerous ramusculi, which soon become sub-cutaneous, and supply the middle part of the thigh, uniting with the anterior crural nerve.

(B.) *Ramus n. cutaneus externus, vel musculo-cutaneus*—arises from the first three pairs of lumbar nerves, which form a kind of plexus, from which three ramuli are sent off.

(*a.*) *Ramulus n. abdominalis*—descends upon the quad-

ratus lumborum, as far as the spine of the ilium, penetrates the transverse muscle, imparting filaments to both, and then divides into two ramusculi.

(α.) *Ramusculus n. externus*—distributes itself to the obliqui and transversalis muscles, and the integuments of the abdomen.

(β.) *Ramusculus n. internus*—descends between the transversus and obliquus internus muscles, runs along the edge of the crural arch as far as the external abdominal ring, where it pierces the tendon of the external abdominal oblique muscle, and is lost on the integuments of the groin and scrotum.

(b.) *Ramulus n. descendens*—passes downwards in front of the iliacus internus muscle, pierces the transversalis muscle at the crista of the ilium, and divides into numerous filaments to supply the muscles of the abdomen, and integuments of the pubic region.

(c.) *Ramulus n. cutaneus.*—The filaments which form this ramulus, may be traced principally to the third pair of lumbar nerves; it takes its course through the psoas muscle, gains its outer edge, passes over the quadratus and iliacus muscles, under Poupart's ligament, close to the anterior and superior spinous process of the ilium, and having gained the thigh, divides into two ramusculi, which penetrate the crural aponeurosis, and are distributed to the integuments of the posterior and outer part of the thigh, some of its filaments descending as low as the outer side of the knee.

(c.) *Ramus n. cruralis*—arises from that part of the lumbar plexus produced by the first four pairs of lumbar nerves; it passes downwards and outwards, between the psoas and iliacus muscles, and opposite to the fourth lumbar vertebra, it gets to the outer side of the psoas, along which it runs, behind the fascia iliaca under Poupart's ligament, to gain the thigh, where it divides into numerous ramuli, which take a superficial and a deep-seated course.

(a.) *Ramuli n. superficiales*—usually about five or six in number, immediately pierce the crural aponeurosis, and di-

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vide into many filaments, which distribute themselves to the
integuments on the inner and anterior part of the thigh,
descending as low as the knee. One ramusculus in parti-
cular, is usually found accompanying the saphena major
vein in the upper part of the thigh.

(*b.*) *Ramuli n. profundi*—divide themselves into an ex-
ternal and an internal set ; they descend outwards, anterior
to the iliacus muscle, and behind the sartorius and rectus,
separating into numerous filaments that are distributed to the
rectus, vastus externus, sartorius, and tensor vaginæ femoris
muscles. The internal set are distributed to the vastus in-
ternus, pectineus, and triceps adductor femoris muscles. It
sends off also—

(*α.*) *Ramusculus n. saphenus*—usually accompanies the
femoral artery within the sheath, as far as the tendinous
canal of the adductor magnus muscle ; this ramusculus then
leaves the artery, passes to the popliteal region, and then
passing downwards between the sartorius and gracilis, and
behind the tendon of the sartorius, about two inches below
the head of the tibia, penetrates the aponeurosis, and be-
coming sub-cutaneous, accompanies the saphena major vein
as far as the great toe, distributing cutaneous filaments in its
course.

(*D.*) *Ramus n. obturatorius*—is smaller than the anterior
crural, and arises from the second, third, and fourth pairs of
lumbar nerves ; it passes downwards and inwards, along the
inner edge of the psoas muscle, in the direction of the
linea ilio pectinea, accompanied by the ramus arteriosus
obturatorius, and gains the obturator internus muscle, which
fills up the obturator foramen ; it sends off a ramusculus
which is distributed to that muscle and to the levator ani ; it
then passes through the foramen, reaches the upper and
inner part of the thigh, and behind the adductor femoris
muscle divides into an anterior and a posterior ramulus.

(*a.*) *Ramulus n. anterior*—passes forwards between the
adductor muscles, which it supplies, as well as the gracilis,
and sends off cutaneous filaments that pierce the fascia

lata, and unite with filaments of the ramus nervosus cruralis.

(*b.*) *Ramuli n. posteriores*—pass backwards to supply principally the adductor magnus muscle, giving filaments also to the obturator externus, and uniting with the ramus n. sciaticus.

(E.) *Ramus n. sacro lumbalis*—is formed by filaments from the anterior branches of the fourth and fifth pairs of lumbar nerves, which having united with each other, pass downwards into the pelvis, in front of the sacrum, to be connected with the sacral nerves, which unite with it to form the sciatic plexus; previous to which, however, the ramus sacro lumbalis sends off—

(*a.*) *Ramulus n. glutæus superior.*—The filaments of this branch may be traced from the fourth and fifth lumbar pairs, or may be said to arise from the sacro-lumbar plexus; immediately it is formed, it passes out of the ischiatic notch above the pyramidal muscle, and divides into ramusculi which take the course of the ramulus arteriosus glutæus profundus, and supply the glutæus medius and minimus muscles.

## Nervi Sacrales,

Consist of six pairs, sometimes however of only five; they arise from the spinal marrow by two sets of filaments, similar to the other spinal nerves, and form the termination of the cauda equina. The ganglia formed by their posterior roots are placed within the sacral canal; the six pair of sacral nerves pass through the anterior sacral foramina, and then divide into posterior and anterior branches.

(27.) *Nervi sacrales primi.*

(A.) *Ramus n. posterior*—is a very small branch, and immediately it has passed through the sacral foramen, it unites with the second pair of sacral nerves, and they together form numerous filaments that supply the sacro-spinalis muscle, and terminates in the glutæus maximus, and integuments of the glutæal region.

(B.) *Ramus n. anterior*—is considerably larger than the

preceding, and unites with the sacral ganglia of the sympa-: thetic nerve, and then passing outwards terminates by assisting in forming the sciatic plexus.

(28 to 30.) *Nervi sacrales*—2nd, 3rd, 4th.

(A.) *Rami n. posteriores*—of all these nerves are alike in passing through their corresponding foramina, uniting with each other, and in being distributed to the muscles and integuments of the nates, hip, and margin of the anus; they, increase from the first to the fourth, and diminish then to the sixth.

(B.) *Rami n. anteriores*—are alike in being united with the sacral ganglia of the sympathetic nerve, and in entering into the composition of the sciatic plexus; they diminish in volume from above downwards.

.(31, 32.) *Nervi sacrales*—5th, 6th.

(A.) *Rami n. posteriores*—are smaller than the posterior branches of the other nerves; they communicate with the fourth pair, and are lost by supplying the parts about the anus.

.(B.) *Rami n. anteriores.*—That of the fifth passes through a foramen common to the sacrum and os coccygis; that of the sixth, if it be present, through a notch in the latter bone. They unite with each other, with the fourth, and with the sacral ganglia of the sympathetic, and supply the coccygeus, levator and sphincter ani muscles; and assist in forming the hypogastric plexus.

### *Plexus Sciaticus,*

Is formed by the anterior branches of the fifth lumbar, and of the four upper pairs of sacral nerves, which unite to produce a large nerve, termed the *nervus ischiadicus.* This plexus is situated, deeply seated, in the lateral region of the pelvis, resting upon the pyramidal muscle, and being covered by the iliac vessels, and viscera of the pelvis; it furnishes numerous rami, which may be distinguished by their distribution into an anterior and posterior set; the anterior supplying the viscera within the pelvis, while the posterior set principally pass out of the pelvis.

(A.) *Rami n. hæmorrhoidales*—are small filaments, which take their origin from the anterior part of the plexus, and immediately penetrate the posterior parietes of the rectum, and then divide into ascending and descending ramuli—the former running upwards towards the sigmoid flexion of the colon, the latter to the sphincter and verge of the anus, accompanied by the arterial ramusculi.

(B.) *Rami n. vesicales*—are variable in number, are frequently united to the last-described rami, passing over the sides of the rectum, they gain the posterior part of the bladder to be distributed to its muscles, and mucous membrane; some of these filaments pass to supply the organs of generation.

(C.) *Rami n. vaginales, et uterini*—arise from the sciatic plexus in common with the last described rami, pass around the rectum, then separate from the vesical nerves, and are distributed to the lateral regions of the vagina, and its mucous membrane; the superior filaments are distributed to the uterus.

(D.) *Ramus n. glutæus inferior*—arises from the posterior part of the sciatic plexus, and from the second and third pairs of sacral nerves, passes out of the pelvis through the sciatic notch, below the pyriform muscle, and then divides into three principal ramuli.

(a.) *Ramulus n. glutæus medius*—ascends and ramifies upon the superior part of the under surface of the glutæus maximus muscle, taking the course of the ramulus arteriosus glutæus superficialis; some of its ramusculi also descend, penetrate the substance of the muscle, in which they are finally lost.

(b.) *Ramulus n. sciaticus, vel pudendalis* — descends downwards and inwards, then turns upwards under the tuberosity of the ischium, when it divides into numerous filaments to supply the inferior part of the glutæus maximus, the integuments upon the inner, and superior part of the thigh, and of the perineum and penis.

(c.) *Ramulus n. cruralis*—is the largest of the three,

passes in front of the glutæus maximus, then becomes sub-
cutaneous, descends in the back part of the thigh, and
expends itself by distributing filaments to the skin which
covers the back part of the leg.

(D.) *Ramus n. pudicus internus*—arises from the third
and fourth sacral nerves, and from the sacral plexus; it is
connected above, with the inferior gluteal nerve, and passes
out of the pelvis with it through the ischiatic notch, below
the pyriform muscle; it then re-enters the pelvis by the
lesser sciatic notch, between the two sacro-sciatic ligaments,
accompanying the ramus arteriosus pudicus, and divides into
two ramuli.

(*a.*) *Ramulus n. inferior*—takes its course forwards,
along the inner side of the tuberosity of the ischium, sending
filaments to the levator and sphincter ani muscles, and skin
and fat about the anus; it still proceeds forwards and up-
wards, along the perineum, between the erector penis, and
accelerator urinæ muscles, to both of which it sends fila-
ments, and is ultimately lost by supplying the scrotum.

(*b.*) *Ramulus n. superior*—leaves the inferior branch,
passing upwards from the ramus of the ischium to that of
the pubes, to gain the symphysis, from whence it passes
between the pubes and the corresponding crus of the penis,
to gain the upper surface of that organ, along which it
passes as far as the corona glandis, where it terminates by
sending filaments to the skin of the prepuce. In this course
it distributes filaments to the obturator muscle, and erector
penis, as well as to the skin.

In the female, the inferior ramulus is much larger than in
the male; it sends off filaments to the perineum, enters the
labium externum, distributes filaments to it, to the constrictor
vaginæ, to the erector clitoridis, and is ultimately lost on the
mons veneris. The superior ramulus, which is comparatively
small, terminates on the clitoris, much in the same manner
as the distribution on the penis of the male.

(E.) *Ramus n. ischiadicus*—is the principal branch of the
sacral plexus, arising from all the nerves which enter into its

formation, namely, the last lumbar, and four superior sacral; it passes out of the pelvis through the sciatic notch, below the pyramidalis, and above the superior geminis muscle; it then descends along the back of the thigh, lying upon the posterior surface of the geminus superior, obturator internus, and quadratus femoris muscles; it is then placed a little to the inner side of the centre of the space between the trochanter major, and tuberosity of the ischium; from this point it descends along the posterior part of the thigh, anterior to the origins of the muscles of the ham-strings, and lying upon the adductor magnus muscle, as far as the popliteal region, where it divides into two principal terminating ramuli. In its course from the pelvis to the ham, it sends off—

(a.) *Ramuli n. musculares*—to the obturator internus, gemini, and quadratus muscles.

(b.) *Ramulus communicans*—which forms a union with the inferior gluteal ramus.

(c.) *Ramuli musculares inferiores*—to supply the biceps, semi-tendinosus, semi-membranosus, and triceps muscles.

(d.) *Ramulus n. cutaneus superior*—is usually separated from the ischiadic ramus, near to its exit from the pelvis; it almost immediately divides into two ramusculi, one of which is distributed to the integuments about the tuberosity of the ischium and nates, while the other passes downwards upon the posterior surface of the thigh, distributing filaments to the skin as far as the calf of the leg.

(e.) *Ramulus n. peroneus, vel popliteus externus*—takes its course downwards, along the inner edge of the biceps muscle, as far as the head of the fibula; it then passes forwards, through the peroneus longus muscle, winds around the neck of the fibula, and then divides into two terminating ramusculi; previous to which, it sends off—

(α.) *Ramusculus n. cutaneus.*—This is sometimes distributed in two or three filaments, which descend along the outer and back part of the leg, between the gastrocnemius externus muscle and the skin, it unites with the cutaneous

filaments of the posterior tibial ramusculus, together supplying the skin in their passage downwards, to the malleolus externus, behind which they pass to terminate by dorsal filaments to the fourth and fifth toes, and filaments to the integuments of the outer side of the foot.

(β.) *Ramusculus n. superficialis, vel musculo-cutaneus*—is separated from the ramulus n. peroneus on the neck of the fibula, from which it passes downwards and forwards, between the peroneus longus, and brevis muscles, to both of which, as well as to the extensor longus digitorum, it sends filaments; and about the middle of the leg, it perforates the fascia, becomes sub-cutaneous, passing downwards towards the outer malleolus, a little above which it divides into an internal and external dorsal ramification; the internal is distributed to the integuments on the dorsum of the foot, and on the first and second toes, communicating with the ramusculus n. saphenus, and with the ramusculus n. tibialis anticus; the external supplies the third, and part of the fourth toe, and communicates with the ramusculus n. cutaneus of the peroneal ramulus.

(γ.) *Ramusculus n. profundus, vel tibialis anterior*—passes through the fibres of the extensor digitorum communis, to gain the anterior surface of the interosseous ligament, where it meets with the ramus arteriosus tibialis anticus, in front of which it descends, they being placed first between the tibialis anticus, and extensor longus digitorum, and then between the tibialis anticus and extensor longus pollicis muscles; they then pass behind the ligamentum annulare, to gain the dorsum of the foot, where the nerve divides into an inner and an outer filament. In this course the ramusculus n. profundus supplies the muscles placed between the tibia and fibula, and one filament rises on the fore part of the knee-joint, and accompanies the ramulus a. recurrens.

The inner dorsal filament continues along the inner edge of the extensor brevis digitorum, which it supplies, as well as the inner interossei muscles, and passing along the space between the metatarsal bones of the first two toes, it dips

down to reach the sole of the foot, accompanying the ramulus a. communicans, and unites with the inner plantar nervous ramification.

The outer dorsal filament passes to the outer side of the dorsum of the foot, where it is distributed to the outer part of the extensor brevis digitorum communis, and the outer interossei muscles.

- (*f.*) *Ramulus n. tibialis posticus, vel popliteus internus* —is the larger division of the sciatic nerve, and descends nearly vertically through the popliteal region, on the outer side of the semi-membranosus muscle, and behind and to the outer side of the popliteal vessels; it then passes behind the knee-joint, between the two heads of the gastrocnemius externus muscle, and then between the gastrocnemius and soleus muscles; when it gains the leg, it is placed immediately behind the tibia, from which situation it receives the name of the tibial nerve. It continues its course downwards, in front of the soleus muscle, and behind the tibialis posticus and flexor longus digitorum, and on the outer side of the ramus a. tibialis posticus. Towards the lower part of the leg, it becomes comparatively superficial, is placed on the inner side of the tendo Achillis dives into the sulcus of the os calcis, between the heel and the inner malleolus, and divides into internal and external plantar ramusculi. In this course, the ramulus tibialis posticus sends off—

(α.) *Ramusculus n. cutaneus tibialis, vel saphenus externus.*—This ramusculus is usually given off immediately above the external condyle of the femur; it descends along the posterior part of the leg, accompanying the saphena minor venous ramulus, and just as it gains the outer side of the tendo Achillis, it becomes united with the cutaneous ramusculus of the ramulus n. peroneus—the two forming a considerable ramusculus; after this union, ramifications are distributed beneath the tendo Achillis, supplying its membranous sheath, and the adjacent parts; the ramusculus then passes behind the external malleolus, takes its course along the superior and external part of the foot, as far as

the metatarsal bone of the little toe, where it divides into numerous filaments to supply the muscles and integument of the dorsum of the foot, and terminates by distributing digital filaments to the two outer toes.

In the popliteal region, the ramulus tibialis posticus sends off muscular filaments to the gastrocnemii, soleus, popliteus, plantaris, and tibialis posticus muscles, as well as to the knee-joint; two or three filaments pass through the inter-osseous ligament, to supply the muscles on its fore part; and just above the malleolus internus, and before its ultimate division, it gives off cutaneous filaments to supply the skin about the inner side of the ankle.

(β.) *Ramusculus n. plantaris internus*—is given off behind the malleolus internus, and posterior to the ramus a. tibialis posticus, which vessel does not divide into its plantar ramuli so soon as the nerve. The ramusculus n. passes forwards along the inner side of the tarsus, above the abductor pollicis muscle, and by the side of the tendon of the flexor longus pollicis, as far as the base of the metatarsal bone of the great toe, where it separates into four digital filaments.

In this course, it sends off filaments to the neighbouring muscles. Its *first digital filament*, takes a course along the tibial side of the great toe; the *second filament*, sub-divides in the space between the metatarsal bone of the great toe and the toe next to it, and supplies the fibula side of the great toe, and the tibial side of the toe next to it; the *third filament*, enters between the second and third metatarsal bones, supplies the lumbricalis muscle, sub-divides into two, which pass to the second and third toes; the *fourth filament*, is in a like manner situated between the third and fourth metatarsal bones, furnishes filaments to the corresponding lumbricalis muscle, and sub-dividing supplies the outer side of the third, and the inner side of the fourth toe.

(γ.) *Ramusculus n. plantaris externus*—is the smaller division of the posterior tibial ramulus; it takes its course forwards and outwards, above the flexor brevis digitorum

muscle, to the posterior extremity of the metatarsal bone of the fifth toe, where it divides into a superficial and a deep-seated filament. The superficial filament, divides into digital filaments to supply the outer side of the fourth, and both sides of the little toe, as well as the corresponding lumbricales muscles. The deep-seated filament, passes obliquely inwards, between the interossei and adductor muscle of the great toe, and is lost by supplying the deep muscles of the plantar region.

# LECTURE XXXV.

THIS nerve is termed the sympathetic, from its forming such frequent and general communication with all the other nerves of the organismus. It differs from the cerebral and spinal nerves, from its apparent origin from ganglia, which are considered by some physiologists as so many centres of nervous influence, or little brains; and which are placed within the cavities of the trunk, and not found any where in the extremities, or exterior of the body.

The ganglia are reddish grey bodies, destitute of any envelope, of different forms, and having nervous cords, which proceed from their circumference either to be connected with other ganglia, or nerves, or to be lost in some particular organ. The cords which leave these ganglia, pass to some other, and are either to be considered as the trunk of the sympathetic nerve, or perhaps as mere cords of communication between the ganglia themselves: in the first case, it premises the nervous cord as the most important part of the sympathetic nervous system, and the ganglia as merely accessory to the function; while in the second case, the ganglia seem to be the important organs, and the cords as mere media of communication: but which ever view we may take of the comparative importance of these parts, it is the best and easiest mode to gain a just knowledge of the system, to describe the ganglia as they are placed in the head, neck, chest, and abdomen; and to describe their cords of junction, as mere nervous communications.

## Ganglia Capitis.

. The first ganglion which is usually described, is the ophthalmic or lenticular ganglion, situated within the orbit; but Ribes, a German anatomist, has described some filaments of the sympathetic nerve continuing in the course of the internal carotid artery, as high as its division into its anterior cerebral branches; and that there the filament on one side unites with that of the opposite, and just over the communicating branch of the two anterior cerebral arterial ramuli, form a little ganglion, which has been named the ganglion of Ribes.

(1.) *Ganglion lenticulare, vel ophthalmicum*—is placed on the outer side of the optic nerve, close to its entrance into the orbit; it is small, somewhat oblong, presenting a convex external surface, opposed to the abductor oculi muscle, and a concave internal surface, connected with the optic nerve; it is surrounded by a considerable quantity of semi-fluid fat: the posterior edge of this ganglion, either receives, or sends off two filaments, one of which passes to unite with the nasal ramulus of the first division of the fifth pair, and the other from its posterior and inferior edge to be connected with the outer ramulus of the third pair of nerves.

The anterior edge of the ganglion supplies two sets of rami, one placed above the other, which are destined to supply the interior of the eye—these are called ciliary nerves; they are very delicate, and of a reddish color.

(A.) *Rami ciliares s. superiores*—composed of five or six filaments, proceed from the upper edge of the ganglion, above the optic nerve, accompanied by filaments from the nasal ramulus of the first division of the fifth, to the ball of the eye.

(B.) *Rami ciliares s. inferiores*—composed of from eight to ten filaments, are placed below and to the outer side of the optic nerve, but frequently unite with each other so as to surround it; arriving at the posterior part of the globe of the eye, all the ciliary filaments traverse the sclerotic coat, pass

forwards between it and the choroid, running parallel with each other, frequently communicating, and reach the ciliary circle or ligament, where each filament divides into two, which are lost, partly in the substance of the ligament, and partly in the iris.

This ciliary circle or ligament, has been considered by some anatomists, as a true ganglion of the sympathetic nerve.

(2.) The *spheno-palatine, or ganglion of Meckel*—is placed within the spheno-maxillary fossa, below the second division of the fifth pair of nerves; it is small, irregular in its form, having a convexity on its outer surface, and being flattened internally towards the lateral nasal, or spheno-palatine foramen. From this ganglion, rami are sent off superiorly, inferiorly, internally, and posteriorly.

(A.) *Rami s. superiores*—from the upper part, two or three rami pass upwards to be connected with the second division of the fifth pair of nerves.

The filaments given off *inferiorly*, are all distributed to the palate, and are termed the palatine filaments; they are three in number. The first is termed—

(a.) *Ramulus s. palatinus magnus.*—It enters the posterior palatine canal, first giving off a small nasal filament, which passes into the nose, and is distributed in the space between the two turbinated bones. The great palatine nerve, continues its course along the palato-maxillary foramen, sending filaments into the nasal fossæ, and is lost by supplying the palate, and gums of the upper jaw.

(b.) *Ramuli s. palatini medii*—descends along the posterior part of the palato-maxillary foramen, and comes out of the canal through a foramen which opens in the fossa between the two pterygoid plates, and then divides to be distributed to the soft palate.

(c.) *Ramuli s. palatini parvi*—is still posterior to the last, and like it, is distributed to the soft palate, the uvula, and the tonsil.

(B.) *Rami s. interni*—are three or four in number, and are

destined to supply the pharynx, and the nose. They are termed the spheno-palatine, or lateral nasal nerves, and pass through the spheno-palatine foramen to gain the nasal fossa, which they enter close to the posterior extremity of the superior turbinated bone, and here spread out upon the pituitary membrane of the superior and middle meatus of the nose, sending also filaments backwards, to supply the pharynx and palate.

There is one filament in particular, termed the—

(a.) *Ramulus s. naso-palatinus*—which takes its course from the superior part of the septum of the nose, descending obliquely forwards behind the pituitary membrane, to the opening of the anterior palatine canal of its own side, which it enters, and passing downwards towards the mouth, reaches the foramen incisivum, produced by the union of the canal from each nostril; and here the naso-palatine ramulus of the one side unites with that of the other, and produces a little enlargement, which has been termed by Cloquet, the *spheno-palatine ganglion*. This ganglion receives a filament from the great palatine ramulus.

(c.) *Ramulus s. posterior, vel vidianus, vel pterygoideus*—directs itself horizontally backwards, through the pterygoid foramen or canal, emerging from which, it divides into two ramuli, first sending off within the pterygoid foramen filaments to the septum of the nasal fossæ, and to the pharynx.

(a.) *Ramulus s. inferior, vel carotideus*—passes immediately in the carotid canal, applying itself upon the coats of the carotid artery, and uniting with the filament which is connected with the sixth pair of nerves; it descends to be connected with the superior cervical ganglion of the sympathetic; forming, therefore, a medium of communication between the spheno-palatine, the cavernous, and the superior cervical ganglia.

(b.) *Ramulus s. superior, vel innominatus*—passes upwards, penetrates the fibro-cartilaginous substance, which closes the foramen lacerum basis cranii anterius, and enters the skull close to the anterior surface of the petrous portion

of the temporal bone, where it enters a groove, which conducts it to a foramen termed the foramen innominatum, and which leads to the canal of Fallopius; here it becomes applied to the trunk of the portio dura, with which it passes to a point, at the posterior and inner wall of the cavity of the tympanum, immediately underneath the base of the pyramid, where a foramen is placed, through which it passes; it then traverses the tympanum from behind forwards, first under the incus, then between its long crus and the upper part of the handle of the malleus, with which it is in contact; it then descends forwards, and passes out of the glenoid fissure, continuing its course downwards and inwards to be connected with the ramusculus lingualis of the third division of the fifth pair, and terminating by forming a kind of ganglion around the submaxillary gland, which has been termed the *submaxillary ganglion.* This filament, therefore, forms a communication between the spheno-palatine, and submaxillary ganglia, and is termed the *chorda tympani.* In its course, it sends off a filament while within the cavity of the tympanum, which passes to the promontory and unites with a filament from the internal carotid filament.

Besides the ganglia we have described, there is generally another, situated within the skull, within the cavernous sinus, termed the *cavernous ganglion;* it is very small, of a reddish grey color, placed to the outer side of the internal carotid artery, and sends filaments to be connected with the sixth, the first division of the fifth, the third pair of nerves, and the lenticular ganglion; and also inferior filaments, which are connected with the superior cervical, and Meckel's ganglion.

### Ganglia Cervicales.

The ganglia which are found upon the neck, are three in number, and are named according to their relative position, with respect to each other.

The *ganglion cervicale superius*—is of an oval form, of a reddish color, and is placed upon the rectus capitis anticus major, behind the carotid artery, and jugular vein; reaching

from the transverse process of the first to that of the third, and sometimes the fourth cervical vertebra, or even lower. Its form and size, are variable; it gives off rami, in the following directions, upwards, downwards, outwards, inwards, and forwards.

(A.) *Rami s. superiores.*—These are two in number, they ascend to enter the carotid canal, and upon the surface of the internal carotid artery, form divisions, so frequently anastomosing with each other, as to produce a distinct plexus; from this plexus a ramulus is connected with the ramulus inferior of the ramus s. vidianus; two or three other ramuli enter the cavernous sinus, and become connected with the sixth pair of nerves, and with the cavernous ganglion, as well as with the first division of the fifth. There are other small ramuli, which pass to the pituitary shaft; also some delicate ramuli pass into the cavity af the tympanum from the carotid canal, where on the promontory they unite with the superior ramulus of the vidian ramus, and with a filament of the glosso-pharyngeal nerve, which latter gains the tympanum through a foramen close to the stylo-mastoid foramen, which opens into that cavity.

According to Ribes, a filament is described as taking the course of the central arterial ramulus of the retina; which he considers as forming a communication between it and the superior cervical ganglion.

(B.) *Ramus s. inferior*—descends from the inferior extremity of the superior, to the middle cervical ganglion, which is situated opposite to the fifth or sixth cervical vertebra, where it terminates; the size of this ramus is variable; its consistence resembles more that of the cerebral, than of the sympathetic nerves; it descends vertically in front of the rectus capitis anticus major, and the longus colli muscles; behind the carotid artery, jugular vein, and pneumo-gastric nerve, exterior to their sheath. In this tract, it receives some filaments from the third and fourth pairs of cervical nerves; it also unites with the external laryngeal ramulus of the par vagum, and sends off two or three delicate filaments, which

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pass into the chest, and assist in forming the cardiac plexus.

(c.) *Rami s. externi*—are numerous; above, they unite by several filaments, with an arch formed around the transverse process of the atlas, by the union of the anterior branches of the sub-occipital, and first pair of cervical nerves; another filament subdivides, and communicates with the anterior branches of the second and third pairs of cervical nerves; while the inferior of these external rami, unite with the anterior branches of the fourth pair of cervical nerves, and with the cervical plexus.

(d.) *Rami s. interni*—are soft and delicate nerves; they distribute filaments to the rectus capitis anticus major, and longus colli muscles; and terminate in the larynx and pharynx—assisting the glosso-pharyngeal, and par vagum nerves in forming the pharyngeal plexus.

(e.) *Rami s. anteriores*—are numerous and large, and have been sometimes called the nervi molles; the upper are the shortest, and ascend to unite with the portio dura, pneumo-gastric, and lingual nerves, soon after they pass out of the skull. The inferior pass downwards, are two or three in number, directing themselves from behind, forwards, to the point of division of the common carotid artery, where they form a plexus, from which numerous ramuli are distributed, with the branches of the common carotid artery, and the carotid plexus; uniting also with filaments from the par vagum, and portio dura. The inferior one or two of these anterior rami unite to form the ramulus cardiacus superficialis, vel superior; of which we shall speak more particularly hereafter.

## Ganglion Cervicale Medius.

This ganglion does not always exist; under which circumstance, the inferior ramus of the superior cervical ganglion descends to the neck of the first rib, to terminate in the inferior cervical ganglion; but when present, it is situated close to the ramulus a. thyroidalis inferior, opposite to the

sixth cervical vertebra. Its form is somewhat rounded; it is bounded behind, by the longus colli muscle, on which it rests; before, by the carotid artery, jugular vein, and pneumo-gastric nerve. It sends off inferior, external, internal, and anterior rami.

(A.) *Rami s. inferiores*—small, usually from five to six in number, descend—some posterior, and some anterior to the subclavian artery, to terminate in the inferior cervical ganglion.

(B.) *Rami s. externi*—sometimes emanate in a single branch, pass outwards usually through the scalenus anticus muscle, and unite with the three inferior cervical nerves.

(C.) *Rami s. interni*—accompany the inferior thyroideal arterial ramulus, around which they form a plexus. Some pass to the thyroideal gland, œsophagus, and trachea, uniting with the recurrent laryngeal ramus n. of the par vagum; and one filament unites with the phrenic nerve.

(D.) *Rami s. anteriores*—are two or three in number, which unite in forming the ramulus s. cardiacus medius, which will be hereafter described.

### Ganglion Cervicale Inferius.

Is very irregular in its form, frequently appearing to consist of several small ganglia, connected by a reddish intermediate tissue; it is situated behind the vertebral artery, between the transverse process of the seventh cervical vertebra, and the neck of the first rib, as well as between the scalenus anticus, and the longus colli muscles; it furnishes superior, inferior, external, internal, and anterior rami.

(A.) *Rami s. superiores.*—Some of these communicate with the middle cervical ganglion, others pass upwards upon the vertebral artery, forming a plexus upon it, and are described as passing upwards as high as the second cervical vertebra, where they unite with the sub-occipital nerve. Small filaments from this *vertebral plexus*, unite with each of the cervical nerves, as they emanate from the intervertebral foramina.

(B.) *Ramus s. inferior*—communicates with the first thoracic ganglion.

(C.) *Rami s. externi*—are very numerous, surround the subclavian artery, around which they form a plexus, and subdivide to accompany the branches of that artery. Some of these rami also unite with the anterior branches of the last four pairs of cervical, and with the first dorsal nerve.

(D.) *Rami s. interni*—are few in number, and take their course partly to the longus colli muscle, and in part assist in forming the pulmonary plexus, and unite with the recurrent laryngeal ramulus of the par vagum, and with the phrenic nerves.

(E.) *Rami s. anteriores*—form the inferior cardiac nerve.

The cardiac nerves should now be described. These are three in number on each side; and as they arise from the superior, middle, and inferior sympathetic ganglia, they are accordingly named the superior, middle, and inferior cardiac rami.

(A.) *Ramus cardiacus superior, vel superficialis*—arises by four or five lower anterior filaments of the superior cervical ganglion; these having united, form a small cord, which descends along the neck, by the side of the trachea and thyroid gland, behind the carotid artery, to the chest. In this course, it sends filaments to assist in forming the pharyngeal plexus; it also sends some to the thyroid gland, and others to be connected with the pneumo-gastric nerve. As it arrives in its descent opposite to the middle cervical ganglion, it sends off a filament, which becomes connected with the inferior thyroideal plexus of that ganglion, and unites with the descending cervical ramus of the hypoglossal nerve. The superior cardiac ramus then enters the chest, behind the subclavian vein, and there becomes intimately connected with the recurrent laryngeal ramus of the par vagum, and with the inferior cervical ganglion. The superficial cardiac nerve of the left side, descends into the chest, between the common carotid, and the subclavian arteries, where it divides into numerous filaments; some of

which pass over the aorta, to unite with the inferior cardiac ramus, and cardiac filaments of the pneumo-gastric nerve; while others pass behind the aorta, and assist in forming the posterior cardiac plexus.

(B.) *Ramus s. cardiacus medius, vel magnus*—is upon the right side larger than the other cardiac nerves; it arises by four or five of the anterior filaments from the middle cervical ganglion, and descends along the inner side of the common carotid artery, passes in front of the subclavian artery to gain the chest; here uniting in its course with the recurrent laryngeal ramus, and pneumo-gastric nerve. It then descends obliquely inwards, passing along the outer side of the arteria innominata, to reach the space between the arch of the aorta and the trachea, where it terminates in the cardiac plexus. On the left side, the middle cervical cardiac ramus s. is not unfrequently wanting, and generally receives its principal branch from the inferior cervical ganglion.

(C.) *Ramus s. cardiacus inferior.*—The filaments which form this ramus on the right side, spring from the inferior cervical ganglion, and immediately form a plexus, which descends vertically behind the subclavian artery, uniting with filaments from the recurrent ramus; they then pass along the left side of the arteria innominata, upon the anterior surface of the arch of the aorta, and between it and the pulmonary artery, assisting in forming the anterior cardiac plexus. Most frequently, on the left side, the middle, and inferior cardiac rami unite to form a single trunk; under which circumstance, the cardiacus superior, and the cardiacus profundus pass separately to the heart; and on the right side, the cardiacus superior and inferior unite, leaving the cardiacus medius to pass separately.

### Plexus Cardiacus.

This plexus is placed behind the ascending aorta, near its origin from the left ventricle, and in front of the right pulmonary artery; it is of an irregular form, and is made up of filaments proceeding from the cardiac rami of the opposite

sides, as well as of filaments from the pneumo-gastric nerves, and their recurrent rami.

In this plexus several small ganglia are enclosed, and to the whole of them the term of cardiac ganglion is sometimes applied. This plexus receives at its upper part, the right and left middle cardiac rami ; on the left side, principally filaments from the cardiacus superficialis; and on the right side, from the ramus cardiacus inferior: while there emanate from this ganglion, anterior, inferior, and posterior rami.

(A.) *Rami s. anteriores*—are small and few in number, and are distributed to the anterior parietes of the aorta.

(B.) *Rami s. posteriores*—terminate in the pulmonary plexus.

(C.) *Rami s. inferiores*—are very numerous, and are distributed especially to the heart ; some of them pass backwards, encircling the posterior coronary artery, and forming a complete plexus around its branches, pass into the substance of the heart, where they terminate ; others pass forwards, surrounding the aorta, and produce the anterior cardiac plexus, between the aorta, pulmonary artery, and vena cava. From the cardiac ganglion, numerous filaments take the course of the pulmonary vessels, unite with filaments of the pneumo-gastric nerve, and assist in forming the pulmonary plexus, which upon the left side surrounds the ductus arteriosus.

### Ganglia Thoracica.

There are twelve ganglia on each side of the thorax, placed behind the pleura, one anterior to the head of each rib: sometimes there are but eleven, the last cervical, and the first dorsal being united. Each of these ganglia is small, and triangular in figure, the first being the largest ; they communicate with one another, and send off external, and internal rami.

(A.) *Rami s. communicantes.*—These are single branches of considerable size, and extend from the inferior edge of the ganglion above, to the superior edge of the ganglion below.

(B.) *Rami s. externi*—from two to four in number from

each ganglion, take their course upwards and outwards, and almost immediately unite with a small branch from the anterior ramus of each dorsal nerve, as it emanates from the intervertebral foramen.

(c.) *Rami s. interni*—are very numerous, and variable in their distribution. Those from the upper ganglia, are the shortest, and terminate in the interior of the chest, communicating frequently with each other in front of the vertebral column, and uniting with the pulmonary plexus. While those from the inferior ganglia are longer, and generally from the sixth to the twelfth, unite to form the two splanchnic rami.

(D.) *Ramus s. splanchnicus major*—arises from the inner edges of the thoracic ganglia, from the sixth to the ninth or tenth, by four or five filaments, which take their course downwards along the sides of the vertebral column, and opposite to the tenth dorsal vertebra unite to form a single branch, which passes through the lesser muscle of the diaphragm into the abdomen; and immediately above the capsula renalis, it divides into numerous filaments to unite with the ramus splanchnicus major of the opposite side, through the medium of the great semilunar ganglion, at the root of the coeliac axis.

(E.) *Ramus s. splanchnicus minor*—is formed by the junction of rami arising from the two or three inferior thoracic ganglia; it passes into the abdomen by perforating the diaphragm behind the great splanchnic branch, and terminates partly by uniting with the greater splanchnic, and in part by forming the renal plexus.

### *Ganglia Abdominales.*

### *Ganglion Semilunare.*

One on each side placed on the pillars of the diaphragm, partly upon the aorta, at the root of the coeliac artery, above and a little behind the capsula renalis; above, the semilunar ganglia receive the greater splanchnic rami; and below, as they converge towards each other, they sometimes unite directly, so as to form but one ganglion; more fre-

quently, however, this union is only by small filaments. That of the right side, is the larger of the two; it is placed between the right pillar of the diaphragm and the vena cava : that of the left side, is placed upon the left pillar of the diaphragm, and generally lies upon the right diaphragmatic artery, being covered by the tail of the pancreas. It is also between the splenic vein, which is above it, and the left renal artery, which is below it.

Both the semilunar ganglia are surrounded by several other ganglia, termed the cœliac, which are connected with each other by numerous short filaments, the whole producing the solar plexus; from which, sets of filaments again are sent off, forming plexuses, taking the course of the arteries from the aorta, and are named accordingly.

(A.) *Plexus s. diaphragmaticus*—arises from the superior part of the solar plexus; there are but few filaments which enter into its composition, and they terminate by taking the course of the diaphragmatic arteries, and by uniting with the phrenic nerve.

(B.) *Plexus s. cœliacus.*—The filaments forming this plexus, are sent off from the inferior part of the solar plexus, assisted by filaments of the pneumo-gastric, and phrenic nerves; when thus produced, it subdivides into three other plexuses.

(a.) *Plexus s. coronarius*—takes its course with the ramus arteriosus coronarius of the cœliac artery, which it embraces near its origin; following the course of the lesser curvature of the stomach, it is distributed to its coats, and communicates with the pneumo-gastric nerve.

(b.) *Plexus s. hepaticus*—much larger than the former, surrounds the hepatic artery, and vena portæ, passing with them through Glisson's capsule to the substance of the liver, to which it is distributed, accompanying the ramifications of the hepatic vessels. It also sends filaments to the ductus communis cholidochus, duodenum, greater curvature of the stomach, and gall bladder; and receives filaments from the right pneumo-gastric nerve.

(c.) *Plexus s. splenicus*—accompanies in a similar manner the ramifications of the splenic artery into the spleen, and like the ramifications of that artery, supplies the pancreas, the left extremity of the stomach, and the omentum.

(c.) *Plexus s. mesentericus superior.*—The solar plexus continues along the fore-part of the aorta, from the cœliac, as low as the superior mesenteric artery, where filaments accompany that vessel, and form the superior mesenteric plexus... This plexus then descends with the superior mesenteric artery, between the pancreas and duodenum, then between the two layers of the mesentery, where it forms a net-work surrounding the mesenteric glands, and which sends off filaments, that follow the course of the arterial rami to the pancreas, duodenum, colon, and cæcum.

(D.) *Plexus s. mesentericus inferior*—is composed of filaments, which proceed along the front of the aorta, down as low as the inferior mesenteric artery, where they take the course of that vessel, and form the inferior mesenteric plexus, being distributed with the arterial branches. Just as it is passing into the pelvis, this plexus divides into two portions —the inner of which takes the course of the common iliac artery, and its distributions; the outer portion passes with the hæmorrhoidal branch of the superior mesenteric artery to the meso-rectum.

(E.) *Plexus s. renalis*—one on each side is made up of filaments from the solar, and cœliac plexus, and from the lesser splanchnic nerve. It is furnished with small ganglia, situated behind the emulgent artery and vein, the ramifications of which they accompany into the substance of the kidney.

(F.) *Plexus s. spermaticus*—formed principally from the renal plexus, and partly also from the superior mesenteric; its filaments take the course of the spermatic artery, in the male, to the testicle, and in the female, to the ovaria and Fallopian tubes.

### Ganglia Lumbales—

Are usually five on either side, placed on the lumbar vertebræ, behind the vena cava on the right, and the aorta on

the left side. They send off communicating external, and internal rami.

(A.) *Rami s. communicantes*—are filaments which unite the five ganglia with each other; these filaments are sometimes united in one cord, at others separated into three or four. The first connects the last thoracic ganglion with the first lumbar, and the lower one, the last lumbar with the first sacral.

(B.) *Rami s. externi*—are usually two or three from each ganglion; they cross in front of the lumbar arteries, the upper filaments being directed obliquely upwards, the middle ones transversely, and the lower ones downwards. They pass between the origins of the psoas muscle, and opposite to the intervertebral foramina unite with the anterior rami of the lumbar nerves.

(C.) *Rami s. interni*—are numerous, but extremely delicate, frequently uniting with each other in front of the aorta; they form the *aortic plexus;* from which filaments are distributed to be united with the several plexuses we have described, and the inferior filaments unite with the hypogastric plexus.

### Ganglia Sacrales.

Are three or four on either side, placed upon the anterior surface of the sacrum, behind the peritoneum; like the lumbar, they send off communicating, external, and internal rami—the two latter, concurring in forming the hypogastric plexus.

(A.) *Rami s. communicantes*—form a junction between each of the sacral, and between the last lumbar and first sacral ganglia.

(B.) *Rami s. externi*—are of considerable size, and unite with the anterior branches of the sacral nerves, partly to be distributed to the levator ani muscle.

(C.) *Rami s. interni*—are small, and unite within the middle of the sacrum from the opposite side; from which union filaments are sent off, that assist in forming the hypogastric plexus.

### *Plexus Hypogastricus.*

This plexus is formed by filaments derived from the sciatic, inferior mesenteric, and aortic plexuses, as well as by filaments from the sacral ganglia.

The hypogastric plexus distributes ramifications to the rectum, bladder, vesiculæ seminales, in the male; uterus, and vagina, in the female; accompanying the arterial branches which are distributed to those parts.

The last pair of sacral ganglia sends off filaments, which pass downwards and inwards on the anterior surface of the os coccygis, on which they unite, producing a little ganglion, which has been termed the *ganglion impar ;* from the under surface of which, delicate filaments are distributed, which lose themselves on the extremity of the os coccygis.

# TABLE OF THE NERVES.

## CEREBRAL NERVES.

1. First pair, or olfactory.
2. Second pair, or optic.
3. Third pair, or motores oculorum.
   - A. *Ramus nervosus superior.*
     - *a.* Ramulus n. musculi recti superioris.
     - *b.* Ramulus n. m. levatoris palpebræ superioris.
   - B. *Ramus n. inferior.*
     - *a.* Ramulus n. m. adductoris oculi.
     - *b.* Ramulus n. m. recti inferioris.
     - *c.* Ramulus n. m. obliqui inferioris.
4. Fourth pair, or pathetici.
5. Fifth pair, or trigeminus.
   - A. *Ramus n. ophthalmicus.*
     - *a.* Ramulus n. lachrymalis.
       - *α.* Ramusculus n. spheno-maxillaris, vel commucans.
       - *β.* Ramusculus n. malaris.
     - *b.* Ramulus n. frontalis.
       - *α.* Ramusculus n. super-trochlearis.
       - *β.* Ramusculus n. supra-orbitalis.
     - *c.* Ramulus n. nasalis.
       - *α.* Ramusculus n. ganglionicus.
       - *β.* Ramusculus n. nasalis internus.
       - *γ.* Ramusculus infra-trochlearis.
   - B. *Ramus n. maxillaris superior.*
     - *a.* Ramulus n. orbitalis.
       - *α.* Ramusculus n. malaris.
       - *β.* Ramusculus n. temporalis.
     - *b.* Ramuli n. dentales posteriores.

     *c.* Ramulus n. infra-orbitalis.

        *α.* Ramusculi n. externi et interni.

        *β.* Ramusculus n. dentalis anterior.

   c. *Ramus n. maxillaris inferior.*

     *a.* Ramulus n. superior.

        *α.* Ramusculi n. temporales profundi

        *β.* Ramusculi n. masseteres.

       . *γ.* Ramusculus n. buccales.

        *δ.* Ramusculi n. pterygoidei.

     *b.* Ramulus n. inferior.

        *α.* Ramusculus n. lingualis, vel gustatorius.

        *β.* Ramusculus n. dentalis inferior.

        *γ.* Ramusculus n. auricularis, vel temporalis superficialis.

6. SIXTH PAIR, OR ABDUCENTES.

7. SEVENTH PAIR—PORTIO DURA, OR FACIAL NERVE.

   A. *Rami n. musculares.*

   B. *Ramus n. auricularis posterior.*

     *a.* Ramulus n. anterior.

     *b.* Ramulus n. posterior.

   C. *Ramus n. stylo-hyoideus.*

   D. *Ramus n. digastricus.*

     *a.* Ramulus n. superior.

     *b.* Ramulus n. inferior.

   E. *Ramus n. temporo-facialis.*

     *a.* Ramuli temporales.

     *b.* Ramuli malares.

     *c.* Ramuli buccales.

   F. *Ramus n. cervico-facialis.*

     *a.* Ramuli n. supra-maxillares.

     *b.* Ramuli n. infra-maxillares.

8. EIGHTH PAIR—PORTIO MOLLIS, OR AUDITORY NERVE.

   A. *Ramus n. cochlearis.*

   B. *Ramus n. vestibuli.*

     *a.* Ramulus magnus.

     *b.* Ramulus medius.

     *c.* Ramulus minimus.

9. NINTH PAIR, OR GLOSSO-PHARYNGEAL NERVES.
    A. *Ramus n. anastomoticus.*
    B. *Rami n. communicantes.*
    C. *Rami n. pharyngei.*
    D. *Ramus n. lingualis superior.*
        a. Ramulus n. tonsillaris.
    E. *Ramus n. lingualis inferior.*
    F. *Ramus n. lingualis medius.*
10. TENTH PAIR—PAR VAGUM, OR PNEUMO-GASTRIC NERVES.
    A. *Rami. n. communicantes.*
    B. *Ramus n. pharyngeus.*
    C. *Ramus n. laryngeus superior.*
        *a.* Ramulus n. laryngeus externus.
        *b.* Ramulus n. laryngeus internus.
            *α.* Ramusculi n. superiores.
            *β.* Ramusculi n. inferiores.
    D. *Rami n. cardiaci.*
    E. *Ramus n. laryngeus inferior, vel recurrens.*
        a. Ramuli n. cardiaci.
        b. Ramuli n. pulmonares.
    F. *Rami n. pulmonares.*
    G. *Rami n. œsophagei.*
    H. *Rami n. ventriculares.*
11. ELEVENTH PAIR—HYPO-GLOSSUS, OR LINGUAL NERVE.
    A. *Ramus n. cervicalis descendens.*
        a. Ramuli n. musculares.
        b. Ramulus n. lingualis.
            α. Ramusculi n. musculares.


## SPINAL NERVES.

1. NERVUS ACCESSORIUS WILLISII.
    A. *Ramus n. communicans.*
    B. *Ramus n. pharyngeus accessorius.*
2. NERVI SUB-OCCIPITALES.
    A. *Ramus n. anterior.*
        a. Ramuli n. musculares.

B. *Ramus n. posterior.*
   *a.* Ramulus n. occipitalis superior et internus.
   *b.* Ramulus n. occipitalis superior et externus.
   *c.* Ramulus n. occipitalis inferior, vel cervicalis.

### NERVI CERVICALES.

3. NERVI CERVICALES PRIMI.
   A. *Ramus n. anterior.*
      *a.* Ramulus n. ascendens.
         *α.* Ramusculi n. communicantes.
      *b.* Ramulus n. descendens.
   B. *Ramus n. posterior, vel occipitalis magnus.*
      *a.* Ramuli n. musculares.
4. NERVI CERVICALES SECUNDI.
   A. *Ramus nervosus anterior.*
      *a.* Ramulus n. ascendens.
      *b.* Ramulus n. descendens.
   B. *Ramus posterior.*
5. NERVI CERVICALES TERTII.
   A. *Ramus n. anterior.*
   B. *Ramus n. posterior.*

### PLEXUS CERVICALIS.

A. *Ramus n. descendens internus.*
B. *Ramus n. diaphragmaticus, vel phrenicus.*
C. *Rami n. descendentes externi.*
   *a.* Ramuli n. supra-claviculares.
   *b.* Ramuli n. supra-acromiales.
   *c.* Ramuli n. sub-claviculares.
   *d.* Ramuli n. cervicales profundi.
D. *Rami n. ascendentes.*
   *a.* Ramulus n. superficialis colli.
   *b.* Ramulus n. auricularis.
   *c.* Ramulus n. occipitalis minor.
6. NERVI CERVICALES QUARTI.
7, 8, 9. NERVI CERVICALES—5th, 6th, 7th.

## Plexus Axillaris.

A. *Rami n. thoracici.*
 *a.* Ramulus n. anterior.
 *b.* Ramulus n. posterior.
B. *Ramus n. suprascapularis.*
C. *Rami n. infra subscapulares.*
D. *Ramus n. articularis, vel circumflexus.*
E. *Ramus n. cutaneus internus.*
 *a.* Ramulus n. externus.
 *b.* Ramulus n. internus.
F. *Ramus n. cutaneus internus minor.*
G. *Ramus n. cutaneus externus, vel musculo-cutaneus.*
 *a.* Ramulus n. posterior.
 *b.* Ramulus n. anterior.
H. *Ramus n. medianus.*
 *a.* Ramuli n. musculares.
 *b.* Ramulus n. interosseous.
 *c.* Ramulus n. palmaris cutaneus.
 *d.* Ramulus n. digitalis primus.
 *e.* Ramulus n. digitalis secundus.
 *f.* Ramulus n. digitalis tertius.
 *g.* Ramulus n. digitalis quartus.
 *h.* Ramulus n. digitalis quintus.
I. *Ramus n. ulnaris, vel cubitalis.*
 *a.* Ramulus n. palmaris.
  *α.* Ramusculus n. profundus.
  *β.* Ramusculus n. superficialis.
 *b.* Ramulus n. dorsalis.
  *α.* Ramusculus n. internus.
  *β.* Ramusculus n. externus.
K. *Ramus n. radialis, vel spiralis.*
 *a.* Ramuli n. musculares.
 *b.* Ramulus n. cutaneus posterior.
 *c.* Ramulus n. anterior, vel superficialis.
  *α.* Ramusculus n. externus.
  *β.* Ramusculus n. internus.

*d.* Ramulus n. posterior.
    *α.* Ramusculi n. posteriores.
    *β.* Ramusculi n. anteriores.

### NERVI DORSALES.

**A.** *Rami n. posteriores.*
    *a.* Ramuli n. interni.
    *b.* Ramuli n. externi.
**B.** *Rami n. anteriores.*

10. NERVI DORSALES PRIMI.
  **B.** *Ramus n. anterior.*
    *b.* Ramulus n. descendens.

11. NERVI DORSALES SECUNDI.
  **B.** *Ramus n. anterior.*
    *a.* Ramulus n. intercostalis.
    *b.* Ramulus n. brachialis.

12. NERVI DORSALES TERTII.
  **B.** *Ramus n. anterior.*
    *a.* Ramulus n. intercostalis.
    *b.* Ramulus n. brachialis.

13 to 16. NERVI DORSALES—4th, 5th, 6th, 7th.
  **B.** *Rami n. anteriores.*
    *a.* Ramuli n. interni.
    *b.* Ramuli n. externi.

17 to 20. NERVI DORSALES—8th, 9th, 10th, 11th.
  **B.** *Rami n. anteriores.*
    *a.* Ramuli n. interni.
      *α.* Ramusculi n. profundi.
      *β.* Ramusculi n. superficiales.
    *b.* Ramuli n. externi.

21. NERVI DORSALES—12th.
  **B.** *Rami n. anteriores.*
    *a.* Ramulus n. communicans.

### NERVI LUMBALES.

22. NERVI LUMBALES PRIMI.
  **A.** *Ramus n. posterior.*

X

B. *Ramus n. anterior.*

23 to 26. NERVI LUMBALES—2nd, 3rd, 4th, 5th.

## PLEXUS LUMBALIS.

A. *Ramus n. spermaticus externus.*
   *a.* Ramulus n. internus.
   *b.* Ramulus n. externus.
B. *Ramus n. cutaneus externus, vel musculo-cutaneus.*
   *a.* Ramulus n. abdominalis.
     *ε.* Ramusculus n. externus.
     *β.* Ramusculus n. internus.
   *b.* Ramulus n. descendens.
   *c.* Ramulus n. cutaneus.·
C. *Ramus n. cruralis.*
   *a.* Ramuli n. superficiales.
   *b.* Ramuli n. profundi.
     *α.* Ramusculus n. saphænus.
D. *Ramus n. obturatorius.*
   *a.* Ramulus n. anterior.
   *b.* Ramuli n. posteriores.
E. *Ramus n. sacro-lumbalis.*
   *a.* Ramulus n. glutæus superior.

## NERVI SACRALES.

27. NERVI SACRALES PRIMI.
A. *Ramus n. posterior.*
B. *Ramus n. anterior.*
28 to 30. NERVI SACRALES—2nd, 3rd, 4th.
A. *Rami n. posteriores.*
B. *Rami. n. anteriores.*
31, 32. NERVI SACRALES—5th, 6th.
A. *Rami n. posteriores.*
B. *Rami n. anteriores.*

## PLEXUS SCIATICUS.

A. *Rami n. hæmorrhoidales.*
B. *Rami n. vesicales.*

c. *Rami n. vaginales, et uterini.*

D. *Ramus n. glutæus inferior.*
    *a.* Ramulus n. glutæus medius.
    *b.* Ramulus n. sciaticus, vel pudendalis.
    *c.* Ramulus n. cruralis.

D. *Ramus n. pudicus internus.*
    *a.* Ramulus n. inferior.
    *b.* Ramulus n. superior.

E. *Ramus n. ischiadicus.*
    *a.* Ramuli n. musculares.
    *b.* Ramulus n. communicans.
    *c.* Ramuli n. musculares inferiores.
    *d.* Ramulus n. cutaneus superior.
    *e.* Ramulus n. peroneus, vel popliteus externus.
        *α.* Ramusculus n. cutaneus.
        *β.* Ramusculus n. superficialis, vel musculo cuta-
          neus.
        *γ.* Ramusculus n. profundus, vel tibialis anterior.
    *f.* Ramulus n. tibialis posticus, vel popliteus internus.
        *α.* Ramusculus n. cutaneus tibialis, vel saphenus
          externus.
        *β.* Ramusculus n. plantaris internus.
        *γ.* Ramusculus n. plantaris externus.

# NERVUS SYMPATHETICUS.

## GANGLIA CAPITIS.

1. GANGLION LENTICULARE, VEL OPHTHALMICUM.
   A. *Rami sympathetici superiores, et inferiores, vel ciliares.*
2. GANGLION SPHENO-PALATINE, OR GANGLION OF MECKEL.
   A. *Rami s. superiores.*
   B. *Rami s. inferiores, vel palatini.*
      a. Ramulus s. palatinus magnus.
      b. Ramuli s. palatini medii.
      c. Ramuli s. palatini parvi.
   c. *Rami s. interni, vel spheno-palatini, or lateral nasal.*
      a. Ramulus s. naso-palatinus.
   D. *Ramus s. posterior vidianus, vel pterygoideus.*
      a. Ramulus s. inferior, vel carotideus.
      b. Ramulus s. superior, vel innominatus.

### GANGLIA CERVICALIA.

Ganglion cervicale superius.
   A. *Rami s. superiores.*
   B. *Ramus s. inferior.*
   c. *Rami s. externi.*
   D. *Rami s. interni.*
   E. *Rami s. anteriores.*

### GANGLION CERVICALE MEDIUM.

   A. *Rami s. inferiores.*
   B. *Rami s. externi.*
   c. *Rami s. interni.*
   D. *Rami s. anteriores.*

### GANGLION CERVICALE INFERIUS.

   A. *Rami s. superiores.*
   B. *Ramus s. inferior.*
   c. *Rami s. externi.*
   D. *Rami s. interni.*
   E. *Rami s. anteriores.*

## RAMI S. CARDIACI.

A. *Ramus s. cardiacus superior, vel superficialis.*
B. *Ramus s. cardiacus medius, vel magnus.*
C. *Ramus s. cardiacus inferior, vel parvus.*

## PLEXUS CARDIACUS, OR CARDIAC GANGLION.

A. *Rami s. anteriores.*
B. *Rami s. posteriores.*
C. *Rami s. inferiores.*

## GANGLIA THORACICA.

A. *Rami s. communicantes.*
B. *Rami s. externi.*
C. *Rami s. interni.*
D. *Ramus s. splanchnicus major.*
E. *Ramus s. splanchnicus minor.*

## GANGLIA ABDOMINALIA.

### GANGLION SEMILUNARE.

A. *Plexus s. diaphragmaticus.*
B. *Plexus s. cœliacus.*
   a. Plexus coronarius.
   b. Plexus hepaticus.
   c. Plexus splenicus.
C. *Plexus s. mesentericus superior.*
D. *Plexus s. mesentericus inferior.*
E. *Plexus s. renalis.*
F. *Plexus s. spermaticus.*

## GANGLIA LUMBALIA.

A. *Rami s. communicantes.*
B. *Rami s. externi.*
C. *Rami s. interni.*

## GANGLIA SACRALIA.

A. *Rami s. communicantes.*
B. *Rami s. externi.*
C. *Rami s. interni.*

## PLEXUS HYPOGASTRICUS.
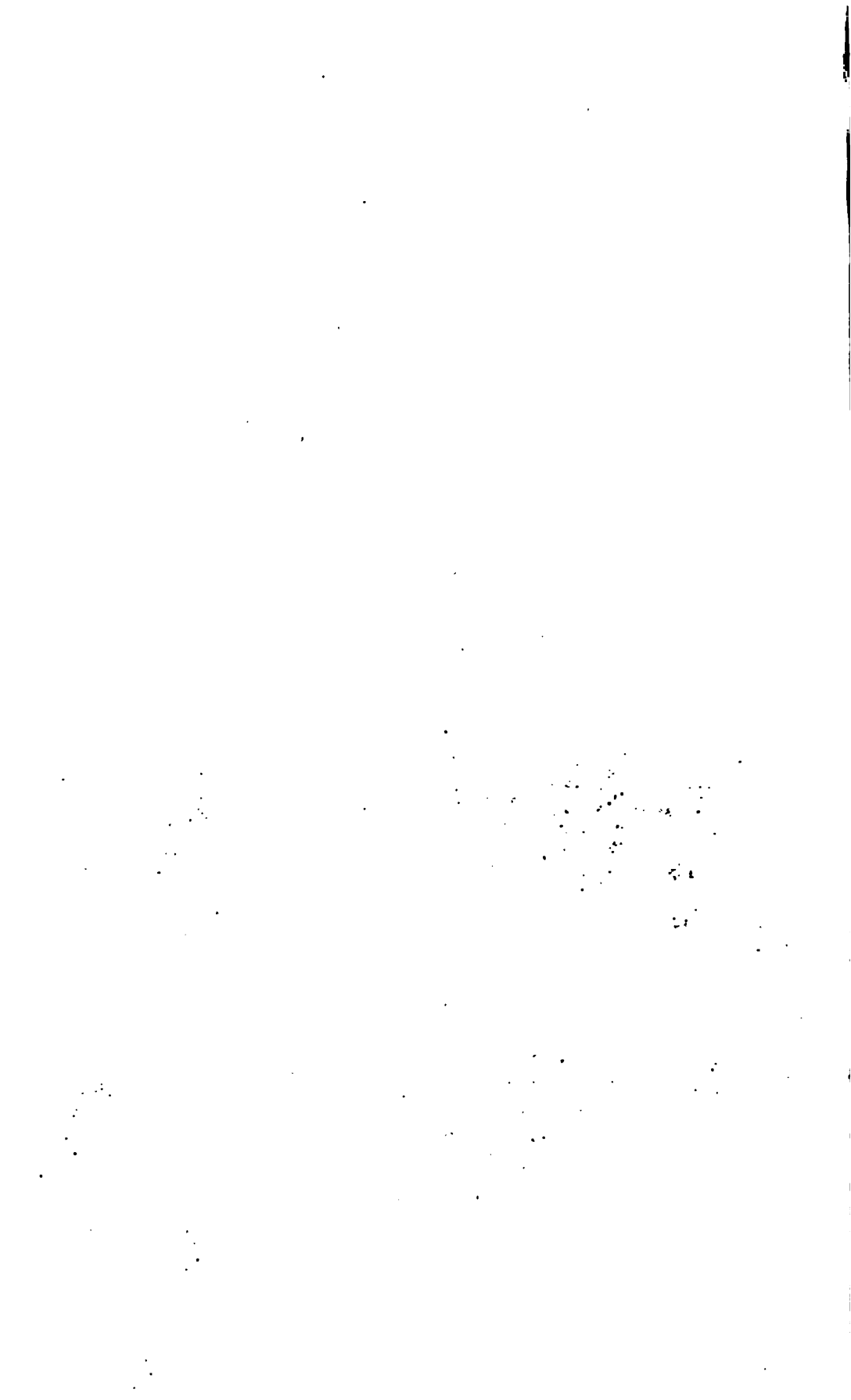
# LECTURES ON ANATOMY.

## PART IX.

## THE ORGANS OF THE SENSES.

# LECTURE XXXVI.

*Descriptive Anatomy of the Organs of Vision.*

THESE organs are placed within those cavities formed by the. junction of the. bones of the face, which are termed the orbits. They have already been described with the bones of. the head. *(Vide* Vol. I. p. 70.*)*

The student, after referring to the osteological description of these cavities, should next examine them in reference to the eyes, and observe how well they are adapted, not only for the purposes of protection, but also to afford a varied range of motion for the purposes of vision. In aid of this object, we find the situation of the orbits contributes much to the perfection of this function; thus the superior and fore part of the head is admirably chosen for many important purposes in the animal economy, as their vicinity to the immediate seat of the intellect, and nervous communication with the brain, render them capable of being adapted, by their exalted position and extensive motion, for the perception of surrounding objects.

It may also be observed, that the orbits are much larger than the globes of the eyes; this is not only for the purposes of. enclosing, at the same time, the numerous muscles, nerves and blood-vessels, which contribute to the function of vision; but also to admit a motion of the eyes, independent of all the other parts of the body. Besides this protection. from the bony orbits, the external delicacy of the eye requires an apparatus for the purpose of defending it from the effects of the air, and other external objects, as well as to moderate and modify the degree of light passing to the organ.

Thus we have surrounding the orbits, the eyebrows, eyelids, eyelashes, meibomian glands, and lachrymal apparatus; all performing their separate functions, in aid of the perfection of vision.

These parts have been termed by Haller, the *tutamina oculi*.

*Of the eyebrows, or supercilia.*—These are two eminences, resting upon the superciliary ridges of the frontal bone, covered by short hairs, which are directed from within outwards. They are larger internally, which extremity is called their head, they are arched in their centre, and their thinner and outer extremity is sometimes called their tail. The color of these hairs is usually that of the hair of the head. A considerable quantity of fat is placed between the skin of the eyebrows, and the superciliary ridges of the frontal bone, admitting of a motion produced by the orbiculares palpebrarum, corrugatores superciliorum, and the occipito frontalis muscles.

The eyebrows are supplied with nerves from the first division of the fifth pair, and from the facial; they derive their blood from the temporal, and palpebral ramusculi of the internal carotid arterial ramus.

*Use.*—To protect the eyes from perpendicular rays of light, to prevent the perspiration of the forehead from lodging on the eyelids; and also they may be considered as organs of mental expression, indicating thought, surprise, and anger.

The *eyelids, or palpebræ*—are two moveable curtains, placed in front of the eye, and are distinguished into an upper and a lower. The upper is bounded above by the eyebrow, and the lower one below by the cheek.

When the eyelids are closed, so that their free extremities are in contact with each other, the upper, it may be observed, from its larger size, descends so as to form the greater portion of the covering to the eye; and the motion of the lower eyelid, is comparatively limited. Both lids are convex externally, and concave internally, in a degree cor-

responding to the convexity of the anterior part of the lobe
of the eye. They unite at their transverse extremities,
forming two angles, the inner is the greater; which dispo-
sition depends upon the arrangement of the fibres of the
orbicularis palpebrarum, having a tendon between them
internally and not externally. The skin of both eyelids is
thrown into numerous folds, by the action of the orbicular
muscles; they are more numerous upon the upper, which
are concave downwards, while those of the lower have their
concavities directed upwards.

The free extremities of each eyelid, present numerous
small orifices; towards the internal angle, one may be ob-
served on each lid, which is termed the *punctum lachrymale*.
Besides these, there are little orifices that point out the ter-
mination of the ducts of the meibomian glands, along the
whole length of the lids; these open inwards, towards the
eyes; and in front of them are placed the eyelashes, which
are short stiff hairs—those on the upper lid being directed
upwards, and those on the lower, downwards.

The following tissues, enter into the composition of the
eyelids.

The *skin*—which differs only from the cutaneous covering
of the other parts of the body, in being extremely delicate,
in not being connected to the sub-cutaneous tissues by adi-
pose membrane, and in being semi-transparent. Underneath
the skin is situated the orbicularis palpebræ muscle; towards
the outer circumference of this muscle, the fibres are sepa-
rated widely from each other, so as to afford an indistinct
appearance of muscular fibre; but towards the free edges of
the lids, the fibres are closer, larger, and straighter, forming
what has been considered by some anatomists as a distinct
muscle, which they have named the *m. tarsalis*.

A *fibrous tissue*—is situated under this muscular layer of
each eyelid, which is stronger on the outer side, and is
placed on the upper lid, between the orbicularis and the
tendon of the levator palpebræ superioris, and in the lower
lid, between the orbicularis and the tunica conjunctiva. It

is inserted into the tarsal cartilages, and is connected with the circumference of the orbits; it is particularly obvious on the outer side, but becomes so attenuated on the inner, as to be lost in cellular membrane. The tendinous expansion of the levator palpebræ superioris, crosses this fibrous layer, as it passes to be inserted into the tarsal fibro-cartilage, and serves to strengthen the fibrous tissue of the upper eyelid.

*Fibro-tarsal cartilages* — are one to the upper, and another to the lower lid of each eye. They have their elastic laminæ, placed in the free edges of the lids, at the termination of the fibrous tissues just described. At the inner canthus, the cartilages of the two lids are connected with the tendon of the orbicularis muscle; and at the outer, they terminate by uniting, through the medium of the fibrous tissue, with each other. The fibro-cartilage of the upper lid is larger than that of the lower, and of a different form, so as to enable the one to be distinguished from the other; it is broad in its centre, and contracted at its extremities; the broadest part of the upper measuring usually about six lines, while in the lower it is not more than two; but it presents nearly the same measurement in its whole length. They are convex upon their anterior, and concave upon their posterior surfaces; the latter presenting many vertical grooves, which lodge the meibomian glands. The adherent edges of these cartilages, are attached to the fibrous layers of the eyelids; their free edges are thick, and somewhat bevelled, so that when the eyelids are brought in contact, a little groove is formed by their approximation, which is supposed to be for the purpose of conveying the tears from the outer, to the inner canthus of the eye.

The *meibomian glands*—are small rounded follicles, of a yellow color, which are placed between the tarsal cartilages, and the tunica conjunctiva, arranged in parallel vertical lines. These are described by Soemmerring as being about forty in the upper, and not more than twenty on the lower lid. These follicles communicate with each other, and open at the free extremities of the eyelids, upon the fore part of

the eye, through very minute apertures, which are placed
behind the ciliæ in two transverse rows. The substance
which is secreted by these glands, is of a sebaceous quality,
and sufficiently firm to be squeezed out in a cylindrical
form.

The *ciliæ, or eyelashes*—are strong hairs, placed in rows
upon the anterior free extremity of each eyelid, but are more
numerous and stronger upon the upper, than on the lower.
They are so disposed, that those on the upper are directed
upwards, with a slight curve, and those on the lower lid,
with a curve downwards; so that the convexities formed by
these curves, are opposed to each other when the eyelids are
closed; but the free extremities of the hairs of each eyelash
are so separated, as to prevent their entanglement.

*Tunica conjunctiva, or membrana adnata.*—This mem-
brane belongs to the mucous system, and not only covers
the posterior surface of the eyelids, but also the anterior
surface of the globe of the eye. It is still a matter of dis-
pute, whether or not this membrane is continued over the
transparent cornea; the distinct fibrous or laminated struc-
ture of the cornea, and the complete absence of such an
appearance in the conjunctiva, would lead one to doubt this
being the case: while, again, the continuity of pustular
disease over this portion of the globe of the eye from the
eyelids, seems to argue for the continuation of this mem-
brane over the whole of the fore part of the organ. At the
free edges of the eyelids, the tunica conjunctiva is con-
tinuous with the cutis, and is pierced by the ducts of the
meibomian glands; or more properly, should be considered
as passing into their apertures to form the follicular appa-
ratus, as it passes through the puncta lachrymalia, to form
the lachrymal duct and ductus ad nasum. At the inner
canthus of the eye this tunic forms a fold, presenting a small
projection of a pale red color, which is termed the *caruncula
lachrymalis;* in which may be observed small follicles, and
very minute hairs; and immediately to the outer side of the
caruncula, another indistinct fold may be observed, which

from its situation, and resemblance to a similar structure, but much more developed in certain animals, has been termed the membrana nictatans.

### Practical Remarks.

The use of the eyelids is to protect the eye from light bodies, which are constantly floating in the atmosphere, as well as, by their frequent involuntary closing, to offer a relief to the retinæ by an alternate exclusion and admission of light. They also, by the same motion, convey the tears from the upper and outer part of the orbit to the puncta lachrymalia, which are situated at the inner canthus; this object is not merely to lubricate the surface of the eye, or to wash off light bodies which are brought in contact with it; but to spread over its anterior surface a thin layer of tear, which produces a refractive medium between that of the atmosphere and of the transparent cornea :—a theory, which is proved by the power of vision becoming imperfect when the tear is wiped off the globe of the eye. The eyelids are liable to numerous diseases, from the derangement of the several structures entering into their formation; namely, those of the skin, cellular membrane, muscle, fibrous membrane, fibro-cartilage, meibomian glands, and hairs; each of which are liable to peculiar diseases.

### Of the Parts contained within the Orbit.

It has already been said, that the globe of the eye only in part fills up the orbits; the remaining space being occupied by a considerable quantity of fat, by the muscles, arteries, veins, nerves, and absorbents of the organs.

The adeps contained within the orbit, so surrounds the globe of the eye, as completely to imbed, and form a soft cushion for it, protecting the globe from friction on the bone; and perhaps at the same time, may be useful in moderating the action of the muscles, and preventing too great an alteration in the refractive power of its transparent parts. For these purposes, the adeps within the orbit is found enveloped in large cells, and of a very soft consistence.

The *muscles* of the eye, are six in number—four of which, from their direction, are named the straight, and two the oblique. The levatores palpebrarum superiorum, have already been mentioned (*Vide* Vol. II. p. 71,) as moderators to the orbiculares palpebrarum.

The *recti* muscles—are named according to their use, as levator, depressor, abductor, and adductor muscles.

*Musculus levator oculi*—arises from the upper surface of the foramen opticum, immediately beneath the levator palpebræ superioris, and is somewhat connected with the neurilema of the optic nerve; it then passes forwards on the upper surface of the ball of the eye, where it becomes aponeurotic, and is inserted into the sclerotic coat, anterior to the transverse axis of the globe; its upper surface is covered by the levator palpebræ superioris, from which, anteriorly, it is separated by the tunica conjunctiva. Its inferior surface rests upon the optic nerve, the ramulus a. ophthalmicus, and the nasal n. ramulus of the first division of the fifth pair.

*Use.*—To raise the eye.

*M. depressor oculi*—arises from the under surface of the optic foramen, by a tendon common to it, the adductor and abductor oculi muscles; it passes forwards, along the under surface of the globe of the eye, anterior to the great diameter of which it is inserted, similar to the last-described muscle. Its inferior surface is in contact with a quantity of adeps, and its tendinous insertion is covered by the tunica conjunctiva; its upper surface is in connection with the optic nerve, and the inferior ramus of the third pair.

*Use.*—To antagonize the levator oculi, and consequently to direct the pupil downwards.

*M. abductor oculi*—is placed on the outer side of the orbit; it has a double origin, partly from the optic foramen, and partly from a tendon which is attached to the edge of the foramen lacerum orbitale superius; between which two origins, the third pair of nerves, the sixth, and the ramulus nasalis of the first division of the fifth, enter the orbit. The muscle passes horizontally outwards and forwards, beyond the transverse axis of the globe, to be inserted by an aponeurosis into the sclerotic coat. Its external surface is in contact with the orbitar process of the sphenoid bone, and more anteriorly with the lachrymal gland; its internal sur-

face, with the optic nerve, the lenticular ganglion, and sixth pair of nerves, which ramify on it.

*Use.*—To direct the pupil outwards. The peculiarity to be observed with respect to these muscles, is, that they receive a distinct pair of nerves, namely, the abducentes, which receive a filament from the sympathetic. No clear physiological theory has been formed upon this anatomical fact.

*M. adductor oculi*—arises from the inner side of the optic foramen, from which it passes forwards, anterior to the diameter of the globe, where it becomes aponeurotic, and is inserted into the sclerotic coat. Its internal surface corresponds to the orbitar process of the œthmoid bone, its external to the optic nerve.

*Use.*—To direct the pupil inwards. In taking a view of the direction given by each of these muscles to the globe of the eye, first, by their separate, and secondly, by their collective action, it will be obvious, that the field of motion is as extensive and varied, as the sphere of vision can require; and yet a mystery hangs over the action of two other muscles, which are connected with this organ.

*M. obliquus superior oculi*—arises by a short aponeurosis from the upper and inner part of the optic foramen, where it is somewhat connected with the origin of the levator palpebræ superioris. It proceeds forwards along the orbitar process of the œthmoid bone, towards the internal angular process of the frontal bone, where a cartilaginous pully is fixed, through which the tendon of this muscle passes, and is then reflected, passing from above downwards, backwards, and outwards, to be inserted by aponeurosis midway between the vertical diameter of the globe, and the entrance of the optic nerve.

*Use.*—To draw the point of insertion of the muscle forwards, inwards, and upwards, making the globe of the eye perform a rotatory motion, which directs the pupil downwards, and outwards. These muscles receive the fourth pair of nerves, which are wholly distributed to them.

*M. obliquus inferior oculi*—is situated at the under and fore part of the orbit, arising from the orbitar process of the

superior maxillary bone, above the infra-orbitar foramen, and just to the outer side of the lachrymal groove; from this origin it passes obliquely outwards, backwards, and upwards, to be inserted by a tendinous expansion into the sclerotic coat, behind the transverse axis of the eye, close to the entrance of the optic nerve; its inferior surface lies upon the orbitar process of the superior maxillary bone, the upper is connected with the ball of the eye, and the depressor oculi muscle.

*Use.*—To draw the point of insertion of this muscle forwards, inwards, and downwards, and consequently to direct the pupil backwards, outwards, and upwards. Such would be its separate action; but when in combination with the preceding muscle, they draw the eye forwards, and counteract the combined power of the four straight muscles.

The *lachrymal apparatus*—consists of the lachrymal gland, and lachrymal passages, which are placed within the orbits.

The *lachrymal gland*—is a conglomerate gland, placed in a depression in the upper and outer part of the orbit, on the inner side of the external angular process of the os frontis, above the abductor oculi, and covered by the tunica conjunctiva. It is about the size of a small almond, of a pale red color, of an oval figure; it may be separated in two or three lobes, which are further separable into small granules, connected by cellular tissue. Each of these granules receives a small ramification from the ramulus a. lachrymalis, and from which a small ramification of a vein commences, as well as a distinct excretory duct, which unites with others, so that the whole gland does not produce more than seven or eight ducts, opening upon the inner side of the upper eyelid, arranged in a curved row—the convexity of which is directed upwards. The whole gland is surrounded by a distinct capsule.

The *puncta lachrymalia*—are two small orifices to each eye, one on either eyelid; they occupy the centre of a little tubercle, more or less obvious in different individuals, situated about a line and a half from the inner canthus. That of the

Y

upper eyelid is directed downwards, outwards, and back-·
wards; and that of the lower, upwards, backwards, and out-
wards; both are therefore curved in such a manner that their
convexities are directed towards each other. These puncta
are the orifices of the—

*Lachrymal ducts*—which extend from the puncta to the
lachrymal sac; the upper is rather longer than the lower,
and more curved; both of them open into the sac, rather
above the centre of its outer side, and immediately behind
the tendon of the orbicularis muscle. They usually open
separately into the sac; but sometimes they unite before they
reach it.

*Lachrymal sac*—is a small membranous pouch, composed
of mucous membrane, placed at the inner canthus of each
eye, and lodged in a bony groove formed by the os unguis
and superior maxillary bone. This sac is closed above, and
rises superior to the tendon of the orbicularis muscle, which
covers its anterior surface, as well as some of the fibres of
the orbicular muscle, and the integuments; its inferior extre-
mity is continuous with the nasal ducts.

The interior of the lachrymal sac is lined by a continuation
of the tunica conjunctiva, which afterwards lines the nasal
duct and nose itself; its color is red, and it is always moist-
ened by mucus. Its outer surface is covered by some mus-
cular fibres, besides those of the orbicularis palpebræ, which
have been spoken of by anatomists as a distinct muscle; but
they appear to me to be part of the obliquus inferior, which
may contribute in some measure to press its fluid contents
towards the nose. It receives its blood from the ramusculi
a. palpebrales of the ophthalmic ramulus, and its nervous
filaments from the ramulus n. nasalis.

*Nasal duct.*—The bony canal which has already been
described in Vol. I. p. 72. It is lined by a continuation of the
mucous membrane of the sac, which adheres very firmly to
the periosteum, and opens in the inferior meatus of the nose,
under the inferior turbinated bone, by a small orifice, which
is surrounded by a circular projection of pituitary membrane;

the direction of the duct, from its commencement at the sac
to its termination in the nose, is obliquely backwards, and a
little outwards.

The *tears*—which are secreted by the lachrymal glands, and directed
downwards and inwards by the action of the orbiculares palpebrarum
muscles to the puncta, to be ultimately conveyed to the nose; are a
muco-serous fluid, the specific gravity of which is somewhat greater than
water; and according to Fourcroy, contains water, mucus, muriate of
soda, soda, phosphate of lime, and phosphate of soda.

The saline parts amount only to about 0· 01 of the whole.  Under
common circumstances, the tears are principally, at any rate, in a great
measure removed by evaporation; as may be proved by the liability of
the tears to flow over upon the cheek, when the atmosphere is loaded
with moisture; but when from mental emotion, or any other cause, the
lachrymal gland is excited to inordinate secretion, then the tears fall
upon the cheek, producing what is termed weeping.  The secretions from
the Meibomian glands prevent the tears, in a great measure, from pas-
sing over the lids; as do also the ciliæ, excepting between the puncta
lachrymalia and the inner angle of the eye, where there are no hairs
placed, and where the tears therefore most readily accumulate and pour
over.  Towards this part of the eye, the tears are conveyed by the closing
of the lids; and here the puncta absorb them, probably by capillary at-
traction, and they flow into the lachrymal sac, from which they are pro-
pelled by the action of the orbicular, and perhaps inferior oblique muscles,
into the nasal duct, and from thence into the nose.  Any interruption of the
flow of the tears through the lachrymal passages, produces a consequent
weeping; it may depend upon disease of the puncta, lachrymal sac, or
duct.  If the symptoms depend upon disease of the puncta, or sac, they
may usually be removed by injecting warm water through the lower
punctum; but when they are produced by obstruction in the nasal duct,
the sac should be laid open, and a style passed through the duct into
the nose, and allowed to remain there until the passage is re-established
—or a probe may be passed up the nasal duct from the nose.

### Of the Globe of the Eye.

The parts which compose the globe of the eye, are the
membranes or tunics, the humours, and also substances of
a peculiar nature, as the crystalline lens, and the ciliary
bodies; beside numerous vessels and nerves.  The ball of
the eye is spherical, its greater diameter is from before to
behind, in which direction it is usually about eleven lines in
length; while its other diameters are only ten lines.  The

globe of the eye is not completely circular, the transparent cornea being a portion of a smaller sphere, projecting on its anterior part. This projection forms about a fifth of the ball of the eye.

The eye is bounded anteriorly, by the tunica conjunctiva; posteriorly, by the straight and oblique muscles, vessels, and nerves, and a considerable quantity of fat; above and to the outer side, by the lachrymal gland; below and to the inner side, by the lachrymal passages.

*Tunica sclerotica*—extends from the entrance of the optic nerve, to the circumference of the transparent cornea, forming about four-fifths of the circular investment of the eye; it is a dense, fibrous substance, of a pearly whiteness, and is thicker posteriorly than anteriorly; its external surface is convex, and is covered by the muscles of the eye, and their tendinous insertions, and by the tunica conjunctiva; its inner surface is covered by the choroid coat, with which it is connected by blood-vessels, and nerves, and a delicate cellular membrane. A little to the nasal side, on the posterior surface of the sclerotic coat, is found a perforation for the entrance of the optic nerve; this is sometimes a single foramen, at others a cribriform plate. There are also numerous small foramina, for the passage of the ciliary vessels and nerves. Anteriorly, the sclerotic coat terminates by a circular opening, the edge of which is bifid, to receive the transparent cornea, in a similar manner to that in which the rim of a watch receives the glass; of these bifid edges, the exterior is the largest.

At the point where the muscles of the eye become tendinous, the sclerotic coat acquires the metallic lustre of tendon; while posterior to this point, it presents an opaque whiteness, in which situation it is stronger, and more distinctly fibrous.

At the point where the optic nerve leaves the skull, the dura mater forms a distinct envelope to it, accompanying it as far as the entrance into the sclerotic coat, where it leaves the nerve, and connects itself with that tunic.

*Cornea pellucida*—forms the anterior fifth of the ball of the eye; it is not perfectly circular, its vertical being less than its transverse axis, which is seven lines in length. Its anterior surface is convex, more or less prominent in different individuals, and is supposed by some anatomists to be covered by the tunica conjunctiva, and by others, by a mucous layer of a nature peculiar to itself; its posterior surface is concave, and covered by the serous membrane of the aqueous humor: its circumference is received within the sclerotic coat, in a manner which has already been described, its edge corresponding to the bifid groove which receives it.

The cornea is thicker than the sclerotic, being one third of a line, but is not like it fibrous; being composed of five or six concentric lamellæ, united by a very delicate cellular membrane, containing an aqueous fluid.

*Tunica choroides*—is placed between the sclerotic coat and the retina, and extends from the entrance of the optic nerve to the ciliary ligament; it is of a dark brown color, being composed of a congeries of minute blood-vessels, united by a thin cellular tissue; posteriorly, it presents a narrow opening for the optic nerve; while anteriorly, it unites itself intimately to the ciliary ligament; its outer surface is covered with a brownish pigment, formed of small globules, which after death tinge the inner surface of the sclerotic coat. The inner surface is covered much more abundantly by the pigmentum nigrum, which does not stain the retina, being separated from it by a reflected serous membrane, first discovered by Mr. Jacobs, of Dublin, and now termed the membrana Jacobi.

The choroid coat consists of two layers, which are separable posteriorly, but inseparable when connected with the ciliary ligament; here it becomes puckered, forming a number of delicate folds, which surround the crystalline lens and anterior surface of the vitreous humor. This coat appears to be composed entirely of blood-vessels; the arteries are divided into two sets, the long, and the short; the former are two in number, pass forwards by the sides of the choroid

coat, and reaching the ciliary ligament are directed inwards, to be distributed to the iris: the vessel on the outer side, is a little above that which runs on the inner side of the eye. The short ciliary arteries are much more numerous than the former, pierce the sclerotic coat sooner, and then immediately divide into numerous ramifications, which anastomose upon the choroid coat. The veins of the choroid coat are larger than the arteries, and pass from before backwards, describing arches, and converging towards the posterior part of the eye, where they form three or four distinct venous trunks, which pierce the sclerotic coat, and terminate in the ophthalmic vein, which empties itself into the cavernous sinus. Ruysch separated these vascular distributions from each other, dividing them into two layers, the inner of which has gained the name of the membrana Ruyschiana, and secretes the pigmentum nigrum.

*Ligamentum ciliare*—is a grey ring, of considerable firmness, forming a boundary to the anterior extremity of the choroid coat, and a bond of union between the sclerotic and choroid coats, and the iris. Its broadest part is not more than two lines in breadth, it is of a pulpy consistence, and from receiving the distribution of the ciliary nerves, and sending off other nerves to the iris, it has been considered by some anatomists as a ganglion, although its structure is unknown.

*Of the iris.*—This is a delicate circular membrane, suspended vertically from the ciliary ligament, and behind the transparent cornea, so as to separate the space between the crystalline lens and the cornea into chambers, the anterior of which is much the larger of the two. They communicate with each other freely through the central aperture of the iris, which is called the pupil. The pupil is not placed in the centre of the iris, but rather nearer to its nasal than its temporal side. The iris has the power, during life, of contracting and expanding, so as to vary the dimension of the pupil.

The circumference of the iris corresponds to the ciliary ligament; the opening in its centre forms the limits of the

pupil; its anterior surface, forming the posterior boun-
dary of the anterior chamber of the eye, is covered by the
membrane of the aqueous humor, and presents different
colors in different individuals, but which in some measure
correspond with the color of the hair.   On this surface may
be observed striæ, passing from the outer circumference to-
wards the pupil, where they meet other striæ, appearing like
a fasciculus of circular fibres surrounding the pupil.   These
fibres have been supposed by some anatomists to be mus-
cular; and Dr. Maunroir, of Geneva, considered the radiating
fibres were for the purpose of dilating, while the circular
fibres were for the purpose of contracting the pupil, and
forming a sphincter muscle.

There is every reason to believe that the pupil is under
the influence of a sphincter muscle, which, like the other
sphincters in the body, has a tendency to remain permanently
closed—and to be opened only by the action of its moderators.
This is evinced by the circumstance which occurs upon the
exhibition of a powerful narcotic, which, overcoming the
action of voluntary muscles, leaves the pupil permanently
contracted.   This occurred but a short time since at Guy's
Hospital, in a woman who made an attempt to destroy her-
self, by taking a large quantity of laudanum.

The posterior surface of the iris is covered by pigmentum
nigrum, which, in the intervals of the ciliary processes, is
continuous with the inner surface of the choroid coat; and
when the posterior surface of the iris is washed, a number
of converging striæ may be observed, passing from the cir-
cumference of the pupil, where they become blended, so as
to form a membranous zone.

The iris is abundantly supplied with nerves and arteries,
in a manner which has already been described.   In the
fœtus, the pupil, up to the seventh month of utero-gestation,
is closed by a delicate vascular membrane, termed the mem-
brana pupillaris; which is supposed to be formed of a division
of the aqueous membrane into two distinct bags, uniting at
the pupil, and which afterwards becomes ruptured.

On the choroid coat, ciliary ligament, and iris being dissected off, the retina is exposed—which should next be considered.

The *retina*—as usually described, is placed between the choroid coat, and the vitreous humour; but there is, in fact, placed between them Jacob's membrane, which will be afterwards noticed. The retina extends from the optic nerve, with which it is continuous, nearly as far forwards as the corpus ciliare, within about two lines of which it terminates by a distinct edge. Its structure is soft, and pulpy; and from the manner in which it commences from the optic nerve, it does not seem to be the expansion of that nerve, but rather, as considered by M. Ribes, as a membrane to receive the distribution of its medullary structure. After death, the retina is semi-transparent, and of a pale white color; it appears to be formed of two layers, which are separable, and more readily so when the central artery has been injected. Upon the inner layer, the distribution of this vessel may be traced, rendered quite vascular, while the outer layer is medullary. This division may also be demonstrated by macerating the eye for some days, when the medullary substance may be washed off, and the vascular coat left entire. Anterior to the apparent termination of the retina, just posterior to the corpus ciliare, there is a structure proceeding forwards to the crystalline lens, of which various opinions have been formed. Many anatomists consider it as a continuation of the retina, which they describe therefore, as terminating at the circumference of the lens. The late Sir William Adams considered it as a distinct structure, and from its tenacity and firmness named it the ligament of the retina. At any rate, it is demonstrable that there is a substance resting on the hyaloid membrane, and placed between the defined line, forming the apparent termination of the retina, and the crystalline lens; which to me appears to be a continuation of the tunica vasculosa retinæ—the medullary layer terminating at the point described, two lines posterior to the corpus ciliare; anterior to which its prolong-

ation could afford no service to vision, as the rays refracted by the lens could not impinge it. The inner layer is termed the *tunica vasculosa retinæ*.

On the inner surface of the retina, about two lines to the outer or temporal side of the entrance of the optic nerve, a yellow spot (termed by Soemmerring the " *limbus luteus*,") may be seen, in the centre of which is situated the "*foramen centrale*." These appearances being placed immediately in the axis of vision, have led to much physiological speculation with respect to their use, although little or nothing seems to be known about them.

Besides the two layers of the retina, which have been described, it receives a distinct external covering from Jacob's membrane, which, according to some dissections made by my friend Mr. John Dalrymple, seems to be a distinct serous membrane, covering both the external surface of the retina, and the internal surface of the choroid coat. That a membrane did exist between the retina and choroid coat, was first demonstrated by Mr. Jacob, of Dublin, whose name has been given to it; but he did not describe it as a closed serous bag. This membrane may be shewn, by carefully tearing the choroid through, and everting it, when small portions of Jacob's membrane may be detached from the retina, and by inflation, rendered distinct from the medullary layer.

The *corpus ciliare*—is a dark ring, constituted by the union of all the ciliary processes, posteriorly ; it is bounded behind, by the retina ; before, by the ciliary processes ; on its outer circumference, by the choroid coat; and on its inner, by the hyaloid membrane.

From its anterior edge from sixty to eighty small vasculo-membranous bodies project, placed beside each other, which are the—

*Ciliary processes.*—They pass forwards, surround the circumference of the crystalline lens, projecting into the posterior chamber, and are placed behind the iris and the ciliary ligament. These processes are alternately, long and short;

and as there is a space between each two of them, the hyaloid membrane and circumference of the crystalline lens become stained in these spaces by the pigmentum nigrum, in consequence of the choroid and hyaloid membranes coming in contact.

The form of each ciliary process is triangular; the base is attached to the ciliary body, the apex is free in the posterior chamber of the eye; the superior surface is directed forwards to the iris, and the inferior backwards to the lens.

### The Humours of the Eye.

The *aqueous humour*—enclosed within its proper membrane, is placed immediately behind the transparent cornea, and occupies the anterior and posterior chambers of the eye, so as to be opposed both to the anterior and posterior surface of the iris, and the anterior surface of the crystalline lens. Its quantity is about six grains; it is secreted by its membrane, which is capable of reproducing it in a very short space of time, if it be evacuated either by accident, or during any operation.

The aqueous humour is slightly viscid; it does not coagulate, either by acids or alcohol; nor if submitted to heat, does it deposit any residuum. Its s. g. is 1·0003; it contains, according to Brande, a minute quantity of albumen; and according to Chenevix, gelatin, albumen, and some small quantity of salines.

In the fœtus, the aqueous humour has a reddish tint.

The *crystalline lens*—is placed between the aqueous and the vitreous humours; and with respect to its situation in the eye, is at about the junction of the two posterior thirds with the anterior third of the organ. It is not exactly placed in the centre of the antero-posterior axis of the globe, but rather to its nasal side—its axis corresponding to that of the pupil; it presents two convex surfaces, the posterior of which is more prominent than the anterior. It is surrounded by a fine capsule proper to it, which is described as being denser, and more elastic anteriorly, than posteriorly; its

specific gravity is 1·0790. As to its chemical composition, it differs from the aqueous humour in containing a greater quantity of gelatin, and albumen, and in the absence of saline substances; upon the application of heat, it becomes perfectly opaque. Within its capsule, a small quantity of fluid is contained between it and the lens, which is termed the *liquor Morgagni*—the lens itself being composed of a concentric laminated structure, soft and semi-fluid at its outer surface, and harder as it approaches the centre, where it has a nucleus, nearly of a solid consistence.

The crystalline lens is held in its situation by the splitting of the hyaloid membrane, one layer of which passes anterior, and the other posterior to it. Where the two layers of the hyaloid membrane reach the circumference of the crystalline lens, a triangular space is left, which runs around the lens, and is termed the *canal of Petit*. This canal is intersected by small septa, which give to it a vesicular appearance when inflated.

Such is the description of the canal of Petit, given by most anatomists; but there are others, who believe that the hyaloid membrane does not pass in front of the lens, but that it is situated wholly behind it; and that the membrane of the aqueous humor covers the lens in front, and uniting at its circumference with the hyaloid membrane, assists in forming the canal of Petit. If the lens be boiled, or exposed to maceration, it will separate into a number of triangular pieces, the apices of which are all directed towards the centre.

In the foetus, the lens is of a reddish color, and soft; in the adult, it is transparent; and in old age, it becomes yellow, or of an amber color. The density of the lens gives to it a great refractive power, and its double convexity tends to draw the rays to a focus upon the retina.

The *vitreous humour*—occupies the two posterior thirds of the globe of the eye. It is fluid, perfectly transparent, and when contained within its membrane, forms a tremulous mass. This membrane enters so intimately into the compo-

sition of this part of the eye, that it may be described in two parts—the vitreous fluid, and the hyaloid membrane.

The *vitreous humour* mingles readily with water, does not coagulate by heat; its s. g. is 1·0009, and is therefore rather denser than the aqueous humour; but by chemical analysis, it is found to contain the same principles.

The quantity of this humour, is computed to be not less than one hundred grains.

The *hyaloid membrane*—not only surrounds the vitreous humour, but sends off innumerable processes into it, so as to divide the whole mass into cells, which communicate very freely with each other, so that if one cell be laid open, the whole fluid escapes, although but very slowly, in consequence of the minuteness of the cells. The anterior part of the hyaloid membrane, between the corpus ciliare and the crystalline lens, receives the ciliary processes in little grooves, producing therefore small projections, corresponding with the interspaces of the processes, which are marked by the pigmentum nigrum, in a striated manner, so as to give it the appearance of a disk of a flower, and is sometimes called the *corona ciliaris*.

The *use* of the vitreous humour, is to give a general support to the tunic of the eye; and from its density being less than that of the crystalline lens, it tends to diverge the rays, and to form a larger picture upon the retina.

### Physiology of the Eye.

The function of the eye is termed vision, or the sense of sight, and consists in the perception of the color, form, size, and distance of surrounding objects.

In order to comprehend fully the uses of the several parts of the organ of vision, it is necessary to make a few observations upon the nature, and properties of light; which is the intermediate agent between objects, and the eye, and the cause of those impressions upon which vision depends.

It is unnecessary to enumerate here all the phenomena and properties of light, as this rather belongs to the science of optics. Presuming, therefore, that the student has made himself acquainted with the elements of that science, from the "Lectures on Natural Philosophy," so ably given by my colleague, Mr. Barry, at Guy's Hospital, I shall

touch upon those parts only, which directly bear upon the organisation of the eye—and, first, of the nature of light.

Light has been admitted to be one of the imponderable substances, emanating from the sun, and all luminous bodies.

It is of two kinds, natural, and artificial. Natural light is that which is derived from the sun, and fixed stars; and is so termed, to distinguish it from artificial light, which is derived from the combustion of inflammable substances, and from bodies heated to a state of incandescence.

To these sources, may perhaps be added some minor causes, such as, the state of bodies which, from certain chemical changes, become phosphorescent, or are naturally so, as the glow-worm and fire-fly; or which emit it in concurrence with electrical phenomena.

From either of these sources, light emanates in the form of rays, passing in straight lines, and with a velocity almost inconceivable.

It has been computed, that light travels two hundred thousand miles in a second, or twelve millions in a minute.

Light was, at first, considered as homogeneous; but Sir Isaac Newton discovered, that when a solar ray is made to pass through a prism, it is separated and refracted into rays of different colors, producing what has been termed the solar spectrum: this consists of an oblong image, consisting of rays of seven different colors; namely, violet, indigo, blue, green, yellow, orange, and red, blended into each other, the violet ray forming one boundary, and the red the other. These rays not only differ from each other in their color, but in their illuminating powers, and other circumstances. The greatest illuminating power resides in the lightest yellow, and palest green; the least, in the violet rays.

Dr. Herschel discovered that light also is accompanied by rays which excite heat, and that this power was greater in the red, and least in the violet rays; he also observed a spot, a little beyond the red, in the solar spectrum, where there was no light, but which was even hotter than the red itself; and inferred, that these rays must be less refrangible than those of light. Considerable variation has, however, been found in the situation of these calorific rays, apparently depending on the different powers of refracting caloric, in different transparent media.

Another curious effect, produced by the decomposition of light by the prism, is, the exhibition of its chemical properties in rays, which excite neither light nor heat, but cause rapid chemical effects—hence termed chemical rays.

These, according to Ritter and Wollaston, are most powerful just beyond the violet ray, and diminish from thence progressively to the green, beyond which they are wholly lost; hence the chemical rays are more refrangible than the luminous ones. Another remarkable property

of light has been ascertained by Mrs. Somerville, to belong to the most refrangible or chemical rays; namely, that of imparting magnetic powers to needles, after an exposure of about two hours to a focus of the violent rays.

Certain bodies, as the diamond, and a compound named Canton's phosphorus, have the power of absorbing light upon being exposed to the sun's rays; and are capable of again emitting it for a time, when removed from their influence.

Rays of light, under common circumstances, pass in straight lines, and the bodies through which they pass, are termed media. Now these media, have a power of altering and modifying the course of the ray. This modification is called refraction, the light appearing as if bent or broken; and it depends upon two circumstances:—first, upon the density, secondly, upon the combustibility of the medium through which the ray passes. Thus, when a ray of light passes from a denser to a rarer medium, as from water into air, it is refracted from a line drawn perpendicular to the point of contact; and this refraction will be greater in proportion to the rarity of the fluid into which it passes. When, however, a ray passes from a rarer to a denser medium, as from air into water, a contrary effect ensues; the ray is drawn or attracted towards the perpendicular; and this in proportion to the density and combustibility of the medium.

It was formerly supposed, that this refraction was increased by giving a peculiar shape to the medium, if solid; but this is not the case; for lenses have merely the power of altering the disposition of one ray with respect to another, causing them to approximate, if convex, or recede from each other, if concave. Now a piece of glass with parallel surfaces, of equal density with a convex lens, would produce an equal degree of refraction: in the former instance, passing out or emerging in a direction parallel to that of their impingence, or in which they had passed in, owing to the density being the same throughout; in the latter case, their direction would be unequal, and they would tend to meet in a point or focus, owing to the density, and consequently the degree of refraction being unequal. The distance of this focus may always be determined by referring to the convexity of the lens: for if it be spherical, the focus will be at the distance of one quarter of its diameter; if for a double convex lens, the focus will be situated at the distance of the semi-diameter, of the sphere of which the surfaces of the lens form a part; and if for a plano-convex lens, it will be seen at double the distance of a double convex lens, or at the distance of the diameter, of the sphere of which the lens forms a part. While in concave lenses, their foci will be found bearing the same relation to the concavities of the spheres of which their surfaces form parts.

Concave lenses have the power of diverging the rays of light, as if they proceeded from a point anterior to the lens, and this in proportion to the degree of their concavity.

There are besides what are termed multiplying lenses, consisting of numerous facettes, each of which receiving the light at a separate angle, gives rise to a separate impression upon the retina, and the optical illusion of so many distinct objects.

So far with respect to light passing through transparent media. Now whenever a ray of light meets a body, which is not transparent, hence termed opaque, we find that it rebounds, or is reflected from the surface, and at an angle equal to that at which it falls; thus the angle of reflection is equal to the angle of incidence, and is opposed to refraction; though it may be observed, that a body which refracts light always in some measure reflects it.

Thus the modifications of light, are either transmission, reflection, or refraction; from which modifications, the color and appearance of all surrounding bodies depend. Thus, a body which transmits some rays, and reflects others, has a translucent appearance; such bodies as absorb all the prismatic colors but one, will appear visible by that color or modification which it reflects. It is curious that some bodies appear very different by the light which they reflect, from that which they transmit. Thus, gold by reflected light, is of a brilliant yellow, but by refracted, of a muddy green color.

The operation of light in producing the phenomena of vision, may be considered under two heads;—the perception of color and form, depending directly on the rays of light; and the perception of distance and size of objects, which is attributable to habit and experience, assisted in many instances by the sense of touch.

We will now trace the progress of a ray of light, through the different transparent structures of the eye, in its passage to the retina; and we shall find the organ a most beautifully constructed achromatic instrument, capable of adapting itself not only to the quantity, but the modification of the light which it admits.

Light reflected from opaque bodies, pass off in straight lines in every direction. Some of these rays impinge the transparent cornea; and it is believed that they undergo some slight change in passing through the moisture which covers its anterior surface; which may therefore be considered as essential to perfect vision.

The rays which strike the opaque cornea, are reflected, and according to the laws of optics, at the angle at which they impinged; and do not therefore interfere with the rays to be transmitted. The rays which impinge the transparent cornea, are refracted towards the perpendicular by the density of this structure; and by its convexity, they have a

tendency towards a focus, so as to collect the rays in quantities corresponding to the size of the opening of the pupil: and, indeed, there is reason to believe that a reciprocal accommodation occurs between the refractive power of the transparent cornea, and the contraction or dilatation of the pupil; which, perhaps, we may account for, by the changes which must necessarily take place in the aqueous humour upon any motion of the iris. Thus, when the pupil contracts upon the membrane containing the aqueous humour, the fluid must necessarily be pushed forwards, and the transparent cornea rendered more convex, so as to alter the focus to the contracted dimensions of the pupil; and, on the contrary, when the pupil is large, there is more space through the pupil, for the fluid in its membrane; consequently, less pressure, and less convexity of the transparent cornea, and a proportionable divergent direction of the rays of the enlarged opening. Those rays, however, which do not pass through the pupil, are reflected from the iris, and denote its color.

The rays transmitted by the transparent cornea and aqueous humour, through the pupil to the crystalline lens, now undergo such changes as are produced by a double convex lens, modified, however, by the variety of density in its different layers, as well as by the means which the eye itself possesses of altering its own refractive power. All the light which passes upon the anterior surface of the crystalline lens, is not transmitted, part of it being reflected upon the posterior surface of the iris, where it is absorbed by the pigmentum nigrum. These rays seem to have a considerable effect upon the iris; for the rays which fall upon its anterior surface do not excite its contraction: but those reflected from the anterior surface of the crystalline lens, are absorbed by the pigmentum nigrum, and perhaps produce those particular effects upon the iris.

The rays which pass through the crystalline lens, converge so as to form a focus somewhat anterior to the surface of the retina. Were the two convex surfaces of the crystalline lens segments of the circle formed by the vitreous humour, the focus would then be in its centre; but as the posterior convexity is more prominent than the anterior, the focus cannot be in the centre of the vitreous humour. As soon as the rays emerge from the crystalline lens, they are passing from a denser to a rarer medium, and consequently diverge; by which divergence, a larger picture is presented to the surface of the retina.

In myopia there is a superabundance, in presbyopia a deficiency, in the refracting powers of the eye. In the former instance, the cornea is more prominent, and the crystalline lens more convex than natural; consequently, according to the laws of optics, the focus must be considerably anterior to its natural situation, though this will depend upon

the distance of the object; thus, an object which is near, forming a greater angle, will have its focus still farther removed, so that it will be about its natural situation. Now it is obvious, that any thing which will increase the angle formed by an object, must produce the same effect; this is done by means of a concave lens. In presbyopia, we find the cornea and crystalline lens considerably flattened; so that according to the laws of optics, the focus will be prolonged beyond its natural situation. Here, therefore, any thing which will diminish the angle, will remove this defect: this is done either naturally, by removing the object to a greater distance, or artificially, by means of a convex lens, which, by converging the rays, must necessarily increase the angle at which they fall.

· There is considerable difficulty in comprehending how the eye adjusts itself to the examination of objects at different distances; but it is evident that changes do take place; for if the eye be examined when a person abstractedly brings his mind to dwell upon the consideration of a minute object, the pupil will be seen to contract; and again, if the mind be directed to the imaginary examination of an extended landscape, the pupil will as immediately dilate. These phenomena seem to prove the necessity for some alteration in the adjustment of the globe of the eye; and as we know of no structure capable of being stimulated by the influence of the mind, but muscle, we have some right to infer, that the muscles are the principal regulators of the adjusting powers of the eye.

Let us therefore examine the attachment of these muscles, and we shall find, that they are not only capable of directing the whole organ; but also of producing such changes in its figure, as must materially affect its foci, and refractive powers.

With respect to the iris, no one has yet proved its muscularity; and there are as many reasons to believe it is composed of an erectile tissue, as to admit of its muscular contraction. The ciliary processes, also, yet open a considerable field for investigation to the anatomist, and physiologist. Of these structures, nothing has yet been satisfactorily given.

The pupil becomes motionless, and dilated, upon the division of the fifth pair of nerves; and, according to some anatomists, the same effect takes place after the division of the third pair; and sight is also lost upon the division of the optic nerve. It is evident, that the black pigment is of considerable utility, from the defective vision of albinos, in whom it appears to be deficient of color.

The picture formed on the retina, communicates the impression of distance to the brain, very much by the size of the picture, and the intensity of the light; thus, when two objects are placed at a distance, one

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behind the other, if that which is farthest from the eye receives the brightest light, it will appear the nearest.

I might here dwell upon the diversity of opinion with respect to the central foramen of the retina, placed as it is in the very centre of the axis of vision, whether or not it receives any impression from light. I might speak also of the points of entrance of the optic nerves, which are denied the power of the other parts of the retina, of receiving any impression from light. But these are subjects more for the direct consideration of the physiologist, and therefore should not be here discussed. I would, however, strongly recommend the perusal of Potterfield, on the eye; and the article on optics, by Dr. Brewster, in Reeces Encyclopedia.

The diseases of the eye, have been so ably and frequently written on by various surgeons, and in itself offers so very extensive a subject, that I shall not here enter upon it; but refer my readers to authors who have exclusively paid attention to this branch of surgery.

# LECTURE XXXVII.

### Descriptive Anatomy of the Ear.

THE ear may be divided into three parts: the external or outer, which is for the purpose of collecting sound, and conveying it to the middle part, or cavity of the tympanum, which modifies it, and the internal part, the seat of sensation, and which is capable of appreciating sound.

### Of the external part of the Ear, or Auricle.

The *auricle* in man, although furnished with small muscles, enjoys little or no voluntary motion; but in most animals is capable of both extensive and variable movements. It is situated on either side of the head, at the posterior part of the face, beneath the temple, and in front of the mastoid process of the temporal bone. Its figure is irregularly oval, being larger above than below, and having its greater diameter vertical. The circumference of the oval is free above, posteriorly, and below; while anteriorly, it is connected with the posterior part of the cheek.

Upon the external surface of the auricle, there are numerous elevations and depressions, which form a series of parabolic curves, for the purpose not only of collecting, but also for directing sound into the tympanum. These elevations and depressions have had names given to them, and therefore must be described.

The *helix*—forms the outer inverted rim, commencing in the middle of the auricle, above the opening of the meatus, and directing itself first forwards, then upwards and back-

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wards, forms the circumference of the auricle, and terminates below at the commencement of the lobe. Its inferior extremity is somewhat bifid; its upper limb is connected with another eminence, which is termed the anti-helix, while the lower one is continuous with the lobe. A groove is produced between the helix and the other part of the auricle, which commences in the concha, takes its whole course, and has been termed the *fossa innominata,* which is more or less distinctly marked in different individuals.

The *anti-helix*—commences behind the helix, where it is rising upwards from the concha to form the superior part of the auricle, by two crura, the upper one of which is broader, and more obtuse than the lower or narrower one; they pass backwards, and uniting form one prominence, which is thicker than the helix, becomes thinner however as it passes downwards to terminate just above the anti-tragus, from which it is separated by a depression. The depression between the two crura by which the anti-helix commences, is termed the *fossa navicularis.*

The *tragus*—is a small triangular projection, which overlaps the opening of the meatus auditorius; the base of the triangle is directed forwards towards the cheek, with which it is continuous; and the apex overlaps the meatus. Above it is separated from the helix by a notch, and also below from the anti-tragus, which is posterior to it.

The *anti-tragus*—is in form very similar to the tragus; it is situated below the anti-helix, and behind the tragus, from which it is separated by a notch; its base is towards the lobe of the ear, and its apex is directed upwards, and slightly forwards towards the concha.

The *concha*—is a deep cavity, which is bounded above and behind by the anti-helix, and below by the tragus and anti-tragus; it is divided into two parts, an upper and a lower, by the commencement of the helix; the lower portion of the concha is continuous with the meatus auditorius.

The *lobe of the ear*—is a rounded soft eminence, void of elasticity, which forms the termination of the circumference

of the auricle inferiorly; it does not appear in any way destined to perform any office in the function of the auricle.

The inner surface of the auricle, does not correspond in its convexity to the irregularities produced on the external surface; it is directed towards the head, having generally a slight inclination backwards, which would be more obvious but for the means adopted to prevent this tendency.

The parts which enter into the composition of the auricle, are the skin, fibro-cartilage, ligaments, and muscles.

The *skin*—is extremely thin, and firmly united to the fibro-cartilage by a most delicate cellular membrane, which never contains any fat, as that substance would have prevented the reverberation of sound; but at the lobe, which has nothing to do towards the function of hearing, there we find the skin containing a considerable quantity of adeps. The integument of the auricle, is also furnished with a great number of sebaceous follicles, and on the inner side of the tragus with some small hairs, which seem to be for the purpose of preventing light bodies floating in the atmosphere, from passing into the ear.

The *fibro-cartilage*—is the structure which constitutes the form of the auricle, and possesses flexibility enough to admit of its motions, and elasticity sufficient to maintain its form, and offer the best possible substance to admit of the reverberation of sound. It is this substance which gives the general figure to the auricle, and produces the various eminences and depressions which have been named; but it does not, however, continue throughout the whole surface of the organ, being in some situations deficient: for instance, it is wanting between the helix and the tragus, and also between the termination of the helix and the anti-tragus. It cannot, however, be properly said to be entirely deficient in these parts, as its fibrous tissue continues, but the cartilaginous does not. The lobe also has no fibro-cartilage entering into its composition.

The *ligaments* of the auricle—are three in number, and are for the purpose of fixing it to the side of the head; from

their relative positions, they are termed superior, anterior, and posterior.

The *superior ligament*—passes upwards, from the inner surface of the concha, over the posterior extremity of the zygomatic arch, and is lost by expanding upon the temporal aponeurosis.

The *anterior ligament*—connects the auricle to the zygomatic process; it is attached to it, and to the base of the tragus, being continuous with its fibro-cartilage.

The *posterior ligament*—proceeds from the convexity of the concha, and is directed backwards to the mastoid process, with which it is connected.

The *muscles of the auricle*—are of two kinds; those which are destined to move the whole auricle, and those which act only upon its individual parts. They are all, however, but very indistinct, and by some anatomists the existence of the second class is entirely denied; but as they are frequently found, it is right to describe them, and to consider their absence as the result of disease, and the tenacity with which children's ears are kept confined to the side of the head, for fear they should be directed forwards, as intended by nature.

The muscles common to the auricle, are three in number.

*M. attollens aurem*—is of a thin triangular figure, arising from the temporal aponeurosis, from whence its fibres descend, converging as they pass downwards to be inserted into the superior part of the inner convex surface of the concha. The external surface of this muscle is covered merely by the skin; its internal surface covers the aponeurosis of the temporal muscle; its anterior edge is longer, and more oblique than its posterior edge.

*Use.*—To elevate the auricle, and at the same time to draw it forwards; by which action it enlarges the concha, and opens the meatus auditorius externus.

*M. auricularis anterior*—is smaller than the last-described muscle, and arises from the temporal aponeurosis, at the

posterior extremity of the zygomatic arch, from which point its fibres pass backwards to be inserted into the inner surface of the helix; above, it is bounded by the last-described muscle; while its lower edge has immediately below it, the zygoma.

*Use.*—To assist the attollens in drawing the auricle upwards and forwards.

*M. auricularis posterior, vel retrahens auriculam.*—This muscle is usually composed of three or four distinct bundles, which proceed forwards from the anterior edge of the mastoid process, to be inserted into the inner surface of the lower part of the concha, by distinct aponeurotic fibres.

*Use.*—To draw the auricle backwards, and to contract in some measure, the opening of the meatus externus.

The muscles proper to the auricle, are five in number.

*M. tragicus*—is the largest of the five, and may almost invariably be found ; it is of a triangular form, corresponding to the figure of the tragus; it arises from the base of the tragus, and passes forwards, the fibres converging to be inserted at the apex of that body.

*Use.*—To draw the apex outwards and backwards, and to enlarge the opening of the meatus externus.

*M. anti-tragicus*—passes from the upper part of the fibro-cartilage, supporting the anti-tragus, and fills up the space or notch between the anti-tragus and anti-helix, to the fibro-cartilage of which it is also connected.

*Use.*—Either to direct the apex of the anti-tragus outwards, by which action it enlarges the opening of the meatus, or else to draw downwards the anti-helix; and in this action, perhaps, it renders the whole auricle a better vibratory medium.

*M. helicis major*—is attached to the helix major, just where it is passing above the tragus ; from whence it passes downwards to be inserted into the fibro-cartilage of the helix, where it arises from the concha.

*Use.*—To render the commencement of the helix major tense, and to deepen the concha.

*M. helicis minor*—is situated behind and below the preceding muscle, within the concha, being attached to the commencement of the helix major.

*Use.*—To assist in increasing the concavity of the concha.

*M. transversus auriculæ*—is placed upon the inner or convex surface of the auricle ; it arises from the prominence produced by the fossa innominata, and is lost upon the convexity of the concha.

*Use.*—To diminish the depth of the concha, and antagonize the helices muscles.

The *arteries* of the auricle are derived from the ramulus a. auricularis posterior, and ramulus a. temporalis, of the external carotid ramus.

The *nerves* spring from the auricular ramus n. of the third division of the fifth pair, from the posterior auricular ramus of the portio dura, or seventh pair, and from auricular filaments from the cervical plexus.

Its *absorbents* pass to glands which are placed behind the temporo-maxillary articulation, upon the outer surface of the sterno-cleido mastoideus muscle.

The *meatus auditorius externus*—leads from the auricle to the cavity of the tympanum, and is placed between the mastoid process of the temporal bone, which is behind it, and the temporo-maxillary articulation in front of it, the zygomatic process above it, and the vaginal and styloid processes below it. In the adult subject, it is from eleven to twelve lines in extent, but does not pass in a straight direction, having an obliquity forwards as it passes inwards. It is also curved in this direction in such a manner that its calibre presents a convexity upwards, and a concavity downwards. Its inner extremity terminates obliquely, as if truncated from above downwards, and from without to within, so that its inferior surface is longer than its superior. The meatus auditorius is formed of skin, fibro-cartilage, ceruminous glands, and bone.

The *skin*—is a continuation of the integuments of the

auricle passing into the meatus, and forming upon the external surface of the membrana tympani, a *cul de sac,* from which it is very readily separated by a putrifactive process. As it first enters the meatus, it is of the same thickness as on the auricle, but becomes more and more attenuated as it approaches the tympanum. In its course it is furnished with very small hairs, which are most evident at the commencement of the meatus. It is also perforated by a number of small openings, which are the mouths of the excretory ducts of the ceruminous glands. These are principally situated in the upper and posterior part of the meatus.

The *fibro-cartilage*—is continued from that of the tragus, and also from the inferior part of the concha, forming only a portion of a canal, the interspaces being filled up so as to complete the circle by fibrous tissue; thus connecting the soft with the bony structures of the meatus. The spaces between the fibro-cartilaginous portions, which are filled up by the fibrous tissue, have been termed the fissure of Santorini; the larger of which is at the upper and back part of the meatus.

The *ceruminous glands*—are placed between the skin and the fibro-cartilage, imbedded in cellular membrane; they are most numerous in the upper, and back part in the fissure of Santorini; they are of a reddish yellow color, each being furnished with an excretory duct, to convey their peculiar secretion into the meatus. This secretion is a thick bitter fluid, but slightly soluble in water, and according to Vauquelin, contains an oil, albumen, and coloring matter.

## Of the Tympanum.

The *tympanum*—or middle portion of the ear, is that cavity placed between the meatus auditorius externus, and the labyrinth.

The tympanum is very irregular in its form, but it presents parts of so much importance to the function of hearing, as to

render it quite necessary to subdivide this cavity into different surfaces or walls. It presents, therefore, an external wall, filled by the membrane of the tympanum, and opposed to the meatus auditorius externus; an internal wall, which separates the cavity of the tympanum from the labyrinth; an anterior wall, which is bounded by the eustachian tube; a posterior wall, opposed to the·mastoid process of the temporal bone; a floor, bounded by the carotid canal, and fossa jugularis; and a roof, which is bounded by the opening to the mastoid cells, which pass upwards, backwards, and downwards, to the mastoid process.

The *external wall*—admits of little farther description than that of the membrana tympani, which principally composes it; unless, indeed, we describe the rim of bone which receives that membrane. This aperture, or rim of bone, forms three-fourths of an oval figure; the upper fourth not presenting a continuation of the oval, but an irregular horizontal line, passing from before backwards. The principal irregularity in this line is produced at its upper, and anterior part, for the purpose of containing a membrane, which has been discovered by my friend Mr. Shrapnell; and of which I shall give a short description, with the rest of the membrana tympani.

The *membrana tympani*—forms by far the larger portion of the outer wall, presenting an obliquity from above downwards, and from without to within, so as to form a very acute angle with the inferior surface of the meatus auditorius externus.

The membrana tympani, is covered externally, by the skin of the meatus auditorius, and internally, by the lining mucous membrane of the cavity of the tympanum; while the middle fibrous tissue, is composed of radiating fibres, emanating from the manubrium of the malleus, to pass to the groove which is lodged in the bony ring just described. This membrane then, in fact, admits the manubrium of the malleus, so that the upper two thirds of the membrane are divided into two by this process of bone.

From the upper and anterior part of the membrana tympani, and occupying the irregularity which has been described, in the horizontal upper fourth of the oval rim of bone, there is a membrane differing from the larger portion, in its structure, in the distribution of its fibres, in the plane of its surface, as well as in not being received into a groove.

These circumstances, prove the necessary physiological difference between this portion and the rest of the membrana tympani; the latter being in every way adapted, from its tension, to vibrate; while the former is, from its flaccid state, constituted, rather to annihilate, than to propagate vibration. This portion of the membrane, Mr. Shrapnell has termed the membrana flaccida :—a name aptly chosen, as it points out at once, that the membrana tympani is not only for the purpose of increasing, but under certain circumstances of diminishing the force of vibration. The particular direction of the plane of the membrana tympani, will be mentioned when describing the manubrium of the malleus, upon its attachment to which it depends.

The *inner wall*—presents the following important parts.

The *fenestra ovalis*—has its long axis placed horizontally, and is situated in about the centre of the inner wall, but rather more to its upper and posterior part. The upper part of this oval foramen, has passing over it *a projection*, which marks the course of the canal of Fallopius ; below the fenestra, there is a projection of bone termed the *promontory*, beneath which, and rather posterior to the centre of the fenestra ovalis, is situated the—

*Fenestra rotunda*—which is so overlapped by the promontory, as to require the temporal bone to be held in a particular direction to bring it into view. At the junction of the inner with the posterior wall of the tympanum, *foramina* are found, which admit of the passage of nerves from the canal of Fallopius, as well as from a distinct foramen, through which a filament passes from the glosso-pharyngeal nerve. At the junction of the anterior and inner wall, the

two surfaces concur in forming passages for the entrance of the eustachian tube, and the tensor internus muscle.

The *anterior wall*—in the dry bone, presents little to be observed, beyond the spaces for the eustachian tube, and tensor tympani muscle ; there is, however, above this a small opening, which leads to the fissura Glasseri, to transmit the chorda tympani nerve, and admit the laxator tympani muscle.

The *posterior wall*—is almost a cribriform plate of bone, some of the foramina admitting of the nerves to enter the tympanum from the canal of Fallopius, and others leading into the mastoid cells. Upon this wall is to be observed, pointing to the long axis of the fenestra ovalis, a hollow projection of bone, which is termed the *processus pyramidalis*, and which gives attachment to, and contains the musculus stapedius. On the outer side of this pyramid being nearer to the outer than the inner wall, it is, that the foramen is situated, for the passage of the filament of the glosso-pharyngeal nerve ; and above the pyramid nearest to the inner wall, small foramina are placed, which admit of the nervous filaments from the canal of Fallopius.

The *floor of the tympanum*—furnishes foramina for the entrance of nervous filaments from the carotid canal, which, with the fossa-jugularis, forms its boundary.

The *roof of the tympanum*—presents an opening of considerable size, which leads backwards and downwards, into the mastoid cells, but nothing further worthy of observation.

The *eustachian tube*—which has been described as opening into the anterior part of the cavity of the tympanum, leads from the upper part of the pharynx to the ear, and is termed the iter a palato ad aurem. It is composed of bone, fibro-cartilage, and membrane, is about two inches in length, and in its course from the ear to the pharynx, is directed forwards, inwards, and downwards, terminating near the inner lamina of the pterygoid process of the sphenoid bone, by a large aperture, the sides of which, however, so approximate as to form it into a kind of fissure.

The *bony* part of the eustachian tube, is placed above the

carotid canal, and on the inner side of the fissura Glasseri, in the angle formed by the junction of the squamous with the petrous portion of the temporal bone. The *fibro-cartilaginous portion* does not form the whole circumference of its calibre, but only the inner, and anterior part of the outer wall of the canal; it commences by being attached to the bony irregularities of the eustachian tube; and as it passes forwards, towards the pharynx, it assists in filling up the foramen lacerum basis cranii anterius.

The fibro-cartilage of the eustachian tube—gives attachment to the pterygoideus internus, circumflexus palati, levator palati, and the tensor tympani muscles.

The *membranous portion* of the eustachian tube, forms the principal part of its outer parietes, and unites the two edges of the fibro-cartilage—thus completing the canal. It seems to be a continuation of the mucous membrane of the pharynx, but much lighter in color, as it approaches the ear; and having gained the tympanum, its texture and secretion are quite altered, so as to have led some anatomists to deny the lining of the tympanum by mucous membrane. At its pharyngeal extremity, the mucous membrane is much thicker and redder, and furnished with numerous mucous follicles.

The *ossicula auditus*—or bones contained in the tympanum, are four in number; and are termed the malleus incus, os orbiculare, and stapes.

*Malleus*—is placed on the superior part of the inner side of the membrana tympani, and is furnished with a head, neck, processus gracilis, and the manubrium. The *head* forms the upper part of the bone, is ovoid, presenting posteriorly, a double, smooth, articulatory surface, to be articulated with the incus; this surface is divided into two by a slight non-articulatory process. The *neck* is very small, being scarcely more than a line in length, and unites the head to the manubrium; it is situated at the upper part of the membrana tympani, and gives attachment to a delicate lengthened process, which is termed the *processus gracilis*. This process, passes horizontally outwards and

forwards, to traverse the fissura Glasseri, and gives attachment to the laxator tympani muscle.

The *manubrium*—of the malleus, is narrower than the neck, and passes obliquely downwards, forwards, and outwards, so as to be connected with the membrana tympani, terminating by a thin rounded extremity, which corresponds to the junction of the middle with the inferior third of the membrane. From the upper and outer part of the manubrium, there projects a short process, which is sometimes termed the *processus obtusus*, which is attached by ligament to the bony rim of the outer wall of the tympanum, and forms a fulcrum for the motions of the malleus. This little process, close to its origin from the manubrium, gives attachment to the tensor, or internal muscle of the malleus.

*Incus*—is situated behind the malleus, and to its inner side, nearer to the mastoid cells. It presents a body, and two crura, which are separated from each other, and are of unequal length.

The *body*—or head, is directed forwards, and slightly upwards, and presents a concave, semilunar, articulatory cavity, which is divided into two surfaces to receive the head of the malleus.

The *superior crus*—is the shorter, is strong and thick, and is directed downwards and backwards, to be connected by ligament to the posterior wall of the tympanum, close to the openings of the mastoid cells. This crus forms another fulcrum for the motions of the bones of the ear.

The *inferior crus*—is much the longer, and is directed downwards, forwards, and inwards, to be articulated to the os orbiculare, so that its inferior extremity on its inner side presents a small articular surface ; in this course, the inferior crus of the incus runs nearly parallel with the manubrium of the malleus.

*Os orbiculare*—is a small round bone, placed between the inferior crus of the incus, and head of the stapes; it presents, therefore, an inner, and an outer articular surface, for these two bones.

*Stapes*—is situated between the os orbiculare, and the fenestra ovalis, the long axis of its base being placed horizontally; it is divided into its head, neck, two crura, and base.

The *head*—is directed outwards, and presents a small concave articular surface, to receive the os orbiculare; it is connected to the rest of the bone, by a small *neck*, which results from the union of the two crura, the neck giving attachment to the stapedius muscle. The crura are placed horizontally, one before the other: the *anterior crus*, is longer than the *posterior*, and both of them are curved; they pass to be attached to the base, forming a space, of a parabolic figure, which is filled up by a membrane.

The *base*—forms the inner part of the bone, is a broad and thin plate, of an oval figure, its long axis being placed horizontally, and applied to the fenestra ovalis, which it imperfectly closes, but is connected to its circumference by the membranes of the tympanum, and vestibule.

### Muscles of the Ossicula.

*M. tensor tympani, vel internus malleus*—arises from the petrous portion of the temporal bone, and the osseous canal of the eustachian tube; from this point, it takes its course backwards and outwards, parallel to and above the eustachian tube, enclosed in a distinct canal; when it reaches the cavity of the tympanum, it becomes tendinous, and passes through a hamulary process, at the termination of the canal, and taking its course slightly upwards and outwards, to be inserted into the processus obtusus of the malleus.

*Use.*—To draw the manubrium of the malleus, and consequently the membrana tympani forwards, upwards, and inwards—thus rendering it tense.

*M. laxator tympani, vel malleus externus.*—This muscle arises from the little styloid process, at the extremity of the spine of the sphenoid bone, and from the cartilaginous portion of the eustachian tube, and then passes backwards to enter the glenoid fissure, and thus gain the cavity of the

tympanum, where it is inserted, by passing slightly outwards, into the processus gracilis of the malleus.

*Use.*—Is not, as usually described, to relax the tympanum; this must be obvious at once to any one who examines the direction of its course, and point of attachment to the malleus, which must produce a motion of the membrane, similar to the last-described muscle; and consequently, in concert with it. It may properly enough, therefore, be called the m. tensor tympani externus.

*M. stapedius*—is a delicate round muscle, contained in the cavity of the processus pyramidalis, from the interior of which it arises; its tendon passes out of the foramen at the apex of the pyramid, to be inserted into the posterior crus of the stapes, close to its neck.

*Use.*—To draw the head of the stapes backwards, and elevate the anterior extremity of its base; it may also act upon the whole chain of the ossicula, rendering them tense.

The tympanum is lined by membrane, which is continued from the pharynx, and is therefore a portion of the gastro-pulmonary mucous membrane; but in different parts of its course along the eustachian tube, and more particularly in the cavity of the tympanum itself, its structure and secretion differ so much, as frequently even to lose the character of mucous membrane, and has led some physiologists to deny its existence in these parts.

### The Labyrinth.

The *labyrinth*—is the third, or internal portion of the ear; it is placed between the tympanum, and the meatus auditorius internus, and is composed of the vestibule, semi-circular canals, and cochlea.

The *vestibule.*—In prosecuting the dissection of the ear according to the plan I have here adopted, I should wish first to direct the student's attention to the precise position of the vestibule, which is a cavity placed immediately to the inner side of the fenestra ovalis. This cavity is of an irregular figure, about the size of a swan-shot, presenting strong parietes in every direction; and the following foramina opening into, and from it.

The first opening, is the one we have already described from the tympanum, the fenestra ovalis, which forms the greater portion of the outer wall, or boundary of the vestibule. Posteriorly, there are five openings from the semi-circular canals, the relative position of which will be immediately described. Upon the posterior part of the inner wall, a sixth is found, the entrance of the aqueductus vestibuli, which, externally has already been described to open immediately behind the foramen auditivum internum. The last or seventh opening, is the scala vestibuli, which leads down to, and indeed assists in forming the cochlea. This opening is placed in the inferior part of anterior wall of the vestibule There might also be mentioned some very minute foramina, which give passage to the filaments of the portio mollis.

### Of the Semi-circular Canals.

These are three in number, placed within the substance of the petrous portion of the temporal bone, above and behind the vestibule. Their direction differs; and with respect to the long axis of the petrous portion of the temporal bone, they may be named the vertical, the oblique, and the horizontal canal.

The *vertical*—usually called the superior vertical canal, is intermediate in size, between the oblique and the horizontal; it presents an internal and external crus, and its convexity faces immediately upwards. It is hollow, as its name would imply; and its outer crus opens upon the outer side of the roof of the vestibule, near to the posterior wall. Its inner crus forms a common opening with the superior crus of the oblique canal on the internal wall.

. The *oblique canal*—is placed on the inner side of the other two canals, and is nearly parallel with the posterior surface of the petrous portion of the temporal bone; its convexity is directed towards the mastoid process of the temporal bone; its superior crus opens in common with the internal of the vertical, and its inferior near to the commencement of the scala vestibuli.

2 A

The *horizontal canal*—is the smallest of the three, and is placed below,—each crus opening separately into the vestibule. The outer crus opens immediately below the outer crus of the vertical canal, and the inner opens between the two crura of the oblique canal. The convexity of this canal is directed backwards, towards the mastoid process of the temporal bone.

Where these semi-circular canals terminate in the vestibule, they each enlarge at one of their extremities,—forming what is termed the ampulla.

The ampullæ of the vertical and the horizontal canals, are formed by their outer crura; and in the oblique canal, by its inferior crus. The continuation of these ampullæ, seem to form a large proportion of the cavity of the vestibule; and that of the inferior crus of the oblique, may be traced as continuous with the scala vestibuli.

The *cochlea*—forms a part of the labyrinth; but it may also be said, in some measure, to belong to the cavity of the tympanum, below, and to the inner side of which it is placed. The cochlea is made up of two canals, separated from each other by a spiral process of bone, which are winding around a central pillar called the modiolus, and are all enclosed in the substance of the petrous portion of the temporal bone.

The first canal to be described, is the *scala tympani*—which commences from the fenestra rotunda, passing downwards, forwards, and inwards, and taking the two turns and a half around the modiolus, it terminates at the apex of that pillar of bone in an opening. The roof of this canal is in its whole course formed by the lamina spiralis.

*Lamina spiralis*—commences from the vestibular side of the inner wall of the tympanum, between the fenestra ovalis, and the fenestra rotunda, separating those foramina from each other as the promontory does upon the inner wall of the tympanum; from that point it passes forwards and inwards, until it meets the modiolus, around which it takes two turns and a half; and at the apex or outer extremity of this pillar, it projects a little over the opening of the scala tympani, and

terminates in what is called the hamulary process. From
the anterior part of the vestibule, and consequently above
the lamina spiralis, the *scala vestibuli* commences. This
canal passes downwards and forwards, until it meets with
the modiolus, around which it takes two turns and a half,
terminating at the apex of the modiolus, above the hamulary
process of the lamina spiralis.

The *modiolus*—is a pillar, which crosses at right angles the
petrous portion of the temporal bone, extending from the ter-
mination of the foramen auditivum internum, obliquely out-
wards, to the cupola of the cochlea. The modiolus is conical
in its form, its base is towards the foramen auditivum internum,
and is cribriform for the passage of the portio mollis. The
apex which terminates the modiolus, as well as the scala
vestibuli, the scala tympani, and the lamina spiralis, are all
overlapped by the concave portion of bone termed the
*cupola*, in which there must therefore be placed two open-
ings—one, the termination of the scala tympani, and the
other, the termination of the scala vestibuli. If a fluid were
injected from the vestibule into the cochlea, it would fill both
scalæ, but not pass into the cavity of the tympanum, as the
fenestra rotunda is closed by a membrane.

The bony cavities of the labyrinth are lined by a very
delicate membrane, which proceeds from the cavity of the
vestibule into all the semi-circular canals, forming within
them smaller canals than the bones themselves; and from
the anterior part of the vestibule, it also passes down the
scala vestibuli, covering the upper surface of the lamina
spiralis; it then proceeds to the hamulary process within the
cupola, winds around it to gain the scala tympani, lining it
in a similar manner.

It should be remarked, however, that the lamina spiralis in
separating the scalæ from each other, does not form a com-
plete bony partition; one half being membranous, but that
part of the lamina spiralis which is next to the modiolus, is
bony. The cavity of this mambrane, contains a fluid which
is somewhat viscid, fills all the cavities of the labyrinth, and

is opposed to the ultimate and sentient extremities of the portio mollis.

From the scala tympani, just within the membrana fenestra rotunda, a minute opening, named the *aqueductus cochleæ*, leads to the base of the petrous portion of the temporal bone, where it opens under the dura mater, between the fossa jugularis and carotid canal.

The nerves which supply the organs of hearing, are the portio dura, portio mollis, glosso-pharyngeal, and sympathetic.

The portio dura and the portio mollis together pass into the foramen auditivum internum, at the bottom of which they separate—the portio dura to enter the canal of Fallopius, and the portio mollis to pass through the cribriform openings of the labyrinth. But just before these two nerves separate, according to the recent dissections of my friend Mr. Shrapnell, they decidedly communicate with each other; which circumstance has been denied by most anatomists. The portio dura, soon after it has entered the canal of Fallopius, receives the superior nervous ramulus from the ramus vidianus of Meckel's ganglion, which enters at the foramen innominatum; and these nerves also unite with each other, and together proceed along the canal of Fallopius, in a direction upwards and backwards, over the inner wall of the tympanum, and immediately above the fenestra ovalis; it is then directed downwards and backwards to gain the foramen stylo-mastoideum, where it passes out to be distributed upon the face. In this course, however, immediately behind the fenestra ovalis, and at the base of the processus pyramidalis, there is a foramen which leads from the canal of Fallopius, and through which a nerve passes into the cavity of the tympanum: this nerve has always been hitherto described as the chorda tympani, and taking its course forwards between the manubrium of the malleus and the long crus of the incus, to gain the fissura glasseri, and to be ultimately connected with the ramusculus gustatorius of the ramus n. maxillarius inferior, of the third division of the fifth pair.

Mr. Shrapnell, however, describes the nerve which passes out of this foramen, as dividing into two or three filaments—one passing upon the promontory, to unite with filaments from the carotid canal; another, which passes to the membrane of the stapes; and a third, to the stapedius muscle,: while the chorda tympani, he considers as emanating from the glosso-pharyngeal nerve, entering a foramen immediately anterior to the stylo-mastoid foramen, passing up in the direction of the canal of Fallopius, as far as the posterior wall of the tympanum, upon the outer side of which it opens close so the junction of the straight portion of the bony rim of the membrane of the tympanum with the posterior wall. Through this foramen, the filament of the glosso-pharyngeal nerve passes, and becomes the chorda tympani, taking the course before described.

I think it right, knowing the numerous preparations Mr. Shrapnell has made in the examination of this question, to take this early opportunity of publishing his opinions; although I have not yet satisfied myself of the propriety of his describing the chorda tympani as a branch from the glosso-pharyngeal nerve. But as he is now preparing a work upon the anatomy of the ear, the result of his dissections will soon be laid before the public. It is quite clear, that the nervus innominatus, glosso-pharyngeal, filaments from the portio dura, and from the superior cervical ganglion of the sympathetic nerve, all concur in supplying the parts within the tympanum, and form intimate junctions with each other.

The portio mollis within the meatus auditivus internus, divides into two rami; one passing to the cochlea, the other to the vestibule; the latter enters the vestibule by three ramuli, and is distributed as described, page 241.

### Physiology of Hearing.

The ear perceives sounds, and distinguishes their variety, distance, and intensity: sound bearing the same relation to the ear and its perceptions, that light does to the eye in vision. It will be necessary,

in order to understand the function of the several parts of the ear, to examine and make a few observations upon the nature and properties of sound.

Sound is the result of a vibratory motion among the particles of elastic bodies, which motion is caused by exterior forces, and is capable of being communicated to surrounding bodies, and of being propagated by them.

Thus, the air is the general medium of communication between sonorous bodies and the ear; but as solids also communicate sounds, they also may be made the means of communication, either, directly, through their substance, or by being hollowed so as to concentrate the vibrations—thus increasing the effect of those communicated by the air. The vibratory motion of sounds, may be either slow, or rapid, producing what has been termed acute and grave sounds.

It has been calculated, that the gravest sound consists of thirty-two vibrations in a second, and the most acute, of twelve thousand; these limits constituting the range of appreciable sounds.

Appreciable sounds or tones, are found to bear a certain relation to each other, constituting harmony. Thus, a distinguishable sound or tone of double the number of vibrations of another, has an harmonious relation to it, and is termed its octave; while the intermediate vibrations between one octave and another, produce seven appreciable sounds; these constitute the gamut, or diatonic scale of music, distinguished in musical writing as the notes of the octave, and are lettered a. b. c. d. e. f. g., and are designated by the names ut, re, mi, fa, sol, la, si; the further consideration of which, belongs to the science of music.

Sounds which are not appreciable by the ear, from the number of vibrations, are termed noises.

Besides the tones or notes of the gamut, the ear distinguishes the expression or timbre, depending upon the nature of the sonorous body; thus, when wood or metal is struck, or in the still more familiar instance of the voice, the ear instantly distinguishes each variety of expression.

Sound travels, or is propagated through bodies with various degrees of rapidity. Thus, in air at the rate of one thousand one hundred and thirty feet in a second, or about thirteen miles in a minute; and according to Cladni, in water four thousand nine hundred, in wood twelve thousand feet in a second; it however loses its force or intensity in exact proportion to the square of the distance from whence it emanates; and all sorts of sounds are propagated with the same rapidity, and without change. When sound meets a body that prevents its passing, it is reflected in angles equal to those of incidence: and the impression on the ear of reflected sound, is termed echo. Reflected

sounds are capable of concentration, and will be heard more distinctly at the point of focus.

We should now examine how well the organs of hearing are appropriated to the collection, modification, and perception of sound.

The external ear is placed in the most advantageous situation to be impressed by the air, when influenced by the motions of the particles of a sonorous body. Its form and tissues admit of the impinging air being collected and reflected so as to form a focus upon the meatus auditivus externus: this is produced by the parabolic curves of the eminences and depressions of the external ear. In most animals, the auricle enjoys a considerable degree of motion, so as to be directed either towards or from a sound, as it may either be agreeably or too violently impressed—making this part of the organ a safeguard to the more delicate structures. Man, however, possesses but little of these powers, although more perhaps than at first view we are led to expect; for we have reason to believe, that the external ear performs its part in modifying an intense sound, when by the will it is prepared for any violent concussion.

{The undulating air thus collected by the auricle, and conveyed into the meatus auditorius externus, impinges the membrane of the tympanum, which becomes affected, and as is believed by some physiologists, is in itself capable of modifying the degree of sound it should communicate to the ossicula auditus. The late Sir Everard Home was of opinion, that a muscular structure entered into the composition of this membrane; while it is generally believed, that this membrane is only capable of modifying sound by the action of the muscles of the ossicula. From the membrane of the tympanum, some doubt may arise as to the means by which the sound is conveyed to the labyrinth. By some it is believed, that the small bones alone communicate the sound; by others, that the air contained within the tympanum is the means by which it is conducted: it is right, perhaps, to consider that each assists in the function of the tympanum; as either destruction of the bones, or the absence of air from the tympanum from diseases of the eustachian tube —each causes deafness. Deafness, however, occurring from obliteration of the eustachian tube, does not necessarily prove that the air contained within the tympanum is for the purpose of conveying sound: for its absence may produce deafness, by the outer atmosphere pressing so forcibly upon the membrane of the tympanum, as to prevent the motion of the small bones.

When the fingers are pressed into the meatus, and the outer ear thus closed, hearing is rendered imperfect only, in consequence of the communication being cut off from the external air; but yet certain sounds, such as rumbling noises, are still distinct; which seems to

prove, that there are different means of conveying sounds to the internal ear, by which the nerves may be sensibly affected, whether it be transmitted through the organ of hearing itself, or through the substance of the body.

The small bones of the ear, are so articulated and influenced by muscles, as to form a chain of communication between the membrane of the tympanum and the base of the stapes, which is in contact with the membrane lining the vestibule. Whether these bones actually convey the sound, or only modify its degrees of intensity, is a subject not yet clearly understood by physiologists. The sound having reached the labyrinth, perhaps partly through the medium of the bones impressing the vestibule, partly by the air in the tympanum impinging the membrane of the fenestra rotunda, and probably also assisted by the stapedius muscle, which prepares the labyrinth for the due perception and appreciation of the most delicate varieties in sound. The mode by which the stapedius muscle assists in this function, I shall leave the description of to my friend Mr. Shrapnell, the discoverer of its particular attachments. Whatever may be the means by which sound is conveyed to the labyrinth, little is known how its intricate structures are capable of communicating its influence to the sensorium.

### Practical Remarks.

The ear is liable, as would naturally be inferred from the delicacy of its structure and variety of its tissues, to numerous diseases; the slightest of which interfere with their function.

The diseases of the auricle are most easily treated, because they are more readily detected, and remedies can be more readily applied. Malformation, however, sometimes leads to defective hearing; thus the auricle may be wanting entirely, or its form may be so unnatural as to render it ill fitted to convey sound to the meatus; under these circumstances, acoustic instruments are required. The integument sometimes closes the external opening of the meatus, requiring to be punctured for the purpose of establishing a passage; this, however, is not always effected, as the meatus is occasionally filled up entirely by a fibro-cartilaginous tissue; under which circumstances, the operation must necessarily fail.

Sir Astley Cooper, in his lectures frequently mentioned two cases of malformation of the meatus. In the one, a servant of Dr. Girdleston, of Yarmouth, at the age of fourteen years was restored to hearing, by puncturing the skin which covered the meatus: while in the other, a Scotch boy who called at his house, the removal of the skin produced no good effect—the meatus being filled up. The meatus itself is sometimes so small, as to interfere with the function of hearing; for which

no remedy has been found effectual, although sponge tents, and other modes of dilation, have been attempted. When the meatus is the subject of inflammation, it is always accompanied with a great degree of general excitement; and the strictest antiphlogistic plan should be immediately adopted, to prevent the formation of matter. This, however, does occasionally occur, producing an aggravation of symptoms, and having a tendency to evacuate itself, either into the meatus, or between the auricle and the mastoid cells. As soon as matter can be detected, an opening should be made. When the abscess opens into the meatus, granulations of a peculiar kind form, depending upon the structure of the part; these are sometimes mistaken for polypi; and fatal consequences have ensued from attempts to remove them with forceps. Mild astringent injections, with alterative and tonic medicines, are the means to be adopted in such cases. The diagnostic mark by which these granulations may be distinguished from true polypi, is to be gained by desiring the patient, while closing the nose and mouth, to attempt to blow; when, if it be polypus, air will rush through the membrana tympani by the side of the polypus, as it invariably arises from the cavity of the tympanum, and cannot therefore make its appearance within the meatus without absorption of that membrane.

Extraneous substances, indurated cerumen, and small excrescences from the cuticle of the meatus, should be carefully removed.

### Diseases of the Tympanum

When inflammation first begins, considerable pain is produced, attended with slight deafness, pain in the head, and even sometimes delirium. The patient should immediately be bled, and a few leeches also applied around the ear, saline aperients administered, and indeed the most strict antiphlogistic regimen prescribed. These means may not always be effectual, and matter may form, and make its escape through the membrana tympani; the discharge is ichorous, sometimes tinged with blood, and imparts a yellow tinge to a silver instrument. Great care must be taken in the local treatment of this disease; the mildest astringent injections should be used, with the adoption of the antiphlogistic regimen before prescribed.

Several instances have occurred of fatal consequences, produced by too strong injections. Matter has been found in the cerebellum, and between the dura mater and the temporal bone, the occurrence of which has been frequently recorded; and some have come under my own notice. This discharge of pus is sometimes followed by polypi; these must be removed by the most gentle mechanical means that can possibly be adopted. Inflammation of the tympanum occasionally produces the destruction of the ossicula auditus—generally indicated by a fœtid dis-

charge, and greater degree of deafness than in the other instances. Such cases must be treated rather by constitutional than by local remedies, although mild astringent injections will be found beneficial.

Obstruction of the eustachian tube, frequently arises from syphilitic ulcers, cynanche, or polypi of the nose; deafness is the consequence of this disease, which may be detected by the inability to inflate the membrane of the tympanum; if this effect has been produced by exposure to cold, producing inflammation, it is usually removed by those remedies which relieve the cause; if by polypi pressing on the tube, their removal also effects a cure; if by cicatrix, instruments should be passed through the nose, either to dilate or puncture the commencement of the eustachian tube: but as all these means have in some instances failed, Sir Astley Cooper recommends puncturing the membrane of the tympanum, which immediately restores the patient to hearing. The good effect is, however, but of short duration; for the opening soon closes again, or the membrane is wholly destroyed: either of which circumstances places the patient much in the same situation as he was before the operation. In two or three instances, however, the operation has proved permanently successful.

Of the diseases of the labyrinth, leading to deafness, little or nothing is known; violent concussion, altered function of nerve, inflammation of the lining membrane, may all tend to produce deafness, without leaving any means by which the cause of loss of hearing can be detected: but the local symptoms produced by any of these causes, must be alleviated by such remedies as the circumstances indicate, as they depend principally upon the general health of the patient.

# LECTURE XXXVIII.

DESCRIPTIVE ANATOMY OF THE ORGAN OF SMELL.

THE bony parts of the nose, which are destined to protect
the more delicate structures, which enter into the compo-
sition of the organ of smell, have already been described;
*vide* Vol. I. page 72; but the cartilages, and softer parts,
are now to be considered.

The nose, with respect both to its bony and soft parts,
although varying much in form, may be described as a
pyramidal eminence, reaching from the centre of the forehead
to the upper lip, and bounded on either side by the eyes, and
cheeks. Its lateral surfaces are flattened, and are posteriorly
connected to the cheeks by a deep groove marking the
separation of the alæ, at the lower part; while anteriorly, the
sides meet to form what is termed the bridge of the nose,
which differs in shape in different people, and terminates by a
rounded portion, which is called the lobe; beneath which
are placed two apertures, termed the nostrils.

The upper part of the nose is completely fixed, and the
bones entirely belong to it, which may be considered as con-
taining the true organ of smell; while the lower part is
perfectly moveable, capable of great dilatation and contrac-
tion; and although belonging to and assisting in the function
of smell, is to be considered as more important as a respi-
ratory organ.

Besides the bones, skin, muscles, cartilage, fibro-cartilage,
and mucous membrane, enter into the composition of this
organ.

*Of the skin.*—Little or no difference is observable between
the skin covering the nose and the rest of the face, excepting

that it is not covered with hair. It is connected to the sub-
jacent parts by a delicate cellular membrane, which never
secretes adeps, but unites it with different degrees of firm-
ness in different parts of the nose ; for instance, more firmly
in the mesian line of the bridge, and with the alæ, than in
the other parts. The skin is furnished with a number of
small follicles, which secrete a sebaceous fluid, more espe-
cially in the groove attaching the alæ to the cheeks. These
follicles open into a small oval sac, from which their secre-
tion may be pressed somewhat in the form of a little worm.

The *muscles* of the nose—have already been described
with the muscles of the face. *Vide* Vol. II. p. 69, *et seq.*

The *cartilages*—are three in number, namely, a middle
one, forming a cartilaginous septum, and the two lateral.

The cartilage of the septum, is triangular in its form, and
vertically placed, being connected above with the nasal
process of the ethmoid bone, behind and below with the
anterior edge of the vomer, which has a deep groove to
receive it ; while anteriorly, it is placed between and con-
nected with the two lateral cartilages of the nose, and with
the fibro-cartilages which form the boundaries to the nasal
openings. It is to the anterior edge of this septum that the
two *lateral cartilages* are connected; and from which they
pass to be attached to the nasal, and to the anterior edge
of the nasal processes of the superior maxillary bones. They
are triangular in their form, are covered externally by the
compressores narium muscles; and internally they are lined
by the pituitary membrane.

The *fibro-cartilages* of the nose—produce the apertures
of the nostrils, as well as the alæ. Those of the opening
are very irregular in their form, but are curved upon them-
selves, so as to produce an inner and an outer crus; the
inner curved forwards, and uniting to be connected by liga-
ment with the cartilaginous septum, assist in forming a
septum between the two nostrils ; while the posterior crura,
pass backwards to be connected with the fibro-cartilages of
the alæ; they thus produce apertures of an elleptical form,

which are influenced by the muscles of the upper lip, and by the compressores narium.

The fibro-cartilages of the alæ, are also very irregular in their form, are inconsiderable in size, and are connected with the preceding fibro-cartilages, and with the lateral cartilages of the nose. They seem to be for the purpose of keeping the nostrils constantly open, without the necessity of muscular exertion.

All these parts, as well as the osseous structures before described, are lined by a continuation of the gastro-pulmonary mucous membrane, usually termed either the Schneiderian, or the pituitary membrane.

The *pituitary membrane*—lines the whole of the internal parts of the nose, being continuous at the edges of the nostrils with the common integuments of the face, above with the continuation of the tunica conjunctiva, and behind with the mucous membrane lining the eustachian tubes, pharynx, and larynx. Within the nose, it forms numerous folds and duplicatures, corresponding with all the irregularities of the internal surface of this organ; presenting therefore a very extended secreting surface. To trace it from its commencement at the nasal fossæ, through all its intricate folds, would only be to reiterate the irregularities on the surfaces of the bones which have already been described. It presents through its whole course, an external surface, which is connected with the bones of the nose; while its internal surface presents a spongy red appearance, with distinct villosities, furnished with small follicular openings. The color of the pituitary membrane, is not the same throughout its whole course, being lighter as it approaches the nostrils near which part small hairs, called vibrissæ, may be observed, and are supposed to be for the purpose of preventing foreign substances passing into the nose.

The pituitary membrane which lines the different sinuses opening into the chambers, does not seem to be furnished with follicles, and is of a much whiter color than in the nose. The secretion from this membrane constantly covers its

surface; it is a viscid mucilaginous substance, but little
soluble in water, and of a slightly salt taste. It is secreted
more abundantly by those parts of the membrane which is
least covered by epidermis; the quantity secreted varies from
different circumstances, and is superabundant from the in-
fluence of cold.

The blood which supplies the nose, is conveyed by three
or four ramusculi from the ramulus a. maxillaris internus,
and also from the ramulus a. ophthalmicus of the internal
carotid artery.

The nose receives its nervous influence from the first pair,
or olfactory, from which it derives its perception of smell,
from the first and second divisions of the fifth pair of nerves,
and from Meckel's ganglion.

Its absorbent vessels, pass principally to the glands situ-
ated about the internal jugular vein.

### Practical Remarks.

The nose, from the various structures which enter into its composi-
tion, and from the different functions which it assists in performing, is
rendered peculiarly subject to disease. Perhaps among the most de-
structive to it, are the diseases of its bones, which, from their extreme
delicacy, become quickly destroyed, and leave an irreparable deformity.
Hence the necessity of the earliest attention to the first symptoms indi-
cating these maladies, which are so frequently found to follow an
injudicious use of mercury, and are considered as syphilitic, when in-
deed they are only mercurial. Still, however, small doses of mercury
must be exhibited; and I have usually found the red oxyd, combined
with opium, as the best form of mercury in these cases.

The fibro-cartilages and cartilages of the nose, are not unfrequently
the subject of diseases; and from the little degree of vitality these
structures possess, they have a great tendency to slough, and produce
the most distressing consequences. This disease is usually considered
of a specific character, and is termed lupus or noli me tangere; but as
far as my experience goes, I am more inclined to attribute the ravages
produced, to the peculiarity of the structures affected, and the particular
functions they have to perform keeping them in constant motion, than
to any specific diseased action.

Polypi very frequently form within the cavities of the nose, and when
pendulous, they should be early removed, taking care in the operation

to use as little violence as possible; remembering, any injury to the delicate bones to which they are attached, may lead to their destruction. Constitutional means, such as alterative and tonic medicines, are to be administered after the removal of the polypus, to prevent its recurrence.

In diseases of the antrum, the nose may become secondarily affected; and indeed, the diagnosis may be difficult; but upon examination of the nose, and finding it free from disease, while at the same time there is a foetid smell, and a discharge of unhealthy mucus or perhaps pus, the surgeon's attention should be directed to the antrum; and usually, by striking the second molar tooth with any metallic instrument, a pain shooting into the superior maxillary bone, will indicate the seat of the disorder.

### Physiology of the Sense of Smell.

This sense consists of the perception of odorous particles, emanating from bodies which are termed odoriferous, and which, being given off in all directions, are by the air conveyed into the nose in the act of respiration, and then impressing the sentient extremities of the olfactory nerve convey to the brain the peculiar sense termed smell. The sensorium receiving this impression, if pleasurably affected may particularly exert the organ of smell for a more perfect sensation; and by the will, the moveable parts of the nose are arranged in such a manner as to draw the air more forcibly into the nostrils, so that the odorous particles may not only be more abundant, but be forced upwards into the superior meatus, where the olfactory nerve is distributed: hence it is, that the snufftaker draws down the upper lip to narrow the passages and force the powder into contact with the olfactory nerve. It may be observed, that odorous particles emanate from a great variety of bodies, from some constantly, and in great abundance; and yet these particles are so infinitely minute, that no sensible diminution of weight occurs, although the odoriferous body may have given off its scent for many years.

The circumstances which occasion the odoriferous particles of bodies to be given off, as well as the nature of the particles themselves, are but little understood; it is not however to all bodies that this property belongs, and those in which no scent is perceptible, are termed inodorous.

Some physiologists have attempted to classify odours; but little seems to have been effected in such an arrangement, beyond the natural expressions of weak and strong, agreeable and disagreeable:—distinctions which, however, will vary as frequently as the capricious fancies of different individuals. It has been asserted, that some odours possess poisonous properties; but there is some doubt, whether or not these effects are attributable to absorption, either in the lungs or in the

stomach; whether they may have been conveyed by respiration to the
former, or by deglution to the latter. The atmosphere is the general
medium by which odorous particles are transported; but they are also
said to be given off with considerable force in vacuo; and it has been
conjectured, that they obey laws of reflection similar to light. Little,
however, is yet known upon this subject. Odours combine with various
substances, both liquid and solid; and in this way are preserved for a
considerable length of time. When an odoriferous body is applied to
the nose, its odorous particles are drawn up upon the extended surface
of the Schneiderian membrane, and there mingle with its mucous secre-
tion, which may be rendered more abundant if the odour be too powerful,
so as to dilute them, or by entangling them, assist in retaining the
weaker impressions. For this purpose, the membrane lining the upper
meatus secretes the mucous in the greatest quantity, the cells being
most capacious, and the nerves most abundantly distributed.

# LECTURE XXXIX.

THE mouth might have been described when speaking of
the organs of digestion; but as it is so particularly connected
with the function of taste, and the salivary apparatus, it may
perhaps be as properly considered now, as with the function
of deglutition. The bones which enter into its composition,
have already been described (p. 74, Vol. I.); but the lips,
cheeks, gums, palate, tonsils, salivary glands, and tongue,
all concur in the performance of the function of taste, and
many of them assist in other functions.

The *mouth*—is placed between the two jaws, below the
nasal fossæ, and in front of the pharynx; it presents an oval
cavity, which opens anteriorly by an horizontal aperture,
capable however of considerable variety of figure from the
muscles of the lips.

The interior of this cavity is lined by a mucous membrane,
which, commencing from the cutaneous edge of each lip,
passes to the anterior surface of either jaw, covering the
gums, and forming in the mesian line a frenum to each lip.
It then passes over the gums, dips down into the alveolar
processes, thus enclosing the roots of the teeth; which cir-
cumstance has led some physiologists to describe the teeth
as products of the mucous membrane; from the alveolar
processes, both above and below, it proceeds into the ca-
vity of the mouth; above covering the palate, below the
muscles of the tongue and the tongue itself, forming a
frenum for that organ to unite it with the symphysis of the
lower jaw. It then proceeds backwards, surrounding the

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pillars of the fauces, covering the tonsils, and terminates by being connected with the mucous membrane of the pharynx, larynx, and eustachian tubes. In its course, however, it enters into the excretory ducts of all the glandular and follicular apparatus opening into the mouth.

The *lips*—form the anterior parietes to the mouth, and are connected with the upper and lower jaw, from which they are respectively named. Laterally, they are connected with the cheeks, where they meet, forming their commissure; they each present an attached edge to their respective jaws, and a free edge, which come in contact with each other, are covered by mucous membrane, and form the anterior opening of the mouth. Their free edges can be so perfectly approximated, that all the power of the muscles of expiration is incapable of forcing air between them, although there appears to be but little muscular power used in their approximation. The external surface of each lip is covered with skin, which, after the age of puberty, in the male, is furnished with hair, forming a large portion of the beard. The internal surface is lined by mucous membrane, which in the mesian line forms a frenum to each lip. Between the skin and the mucous membrane, the muscles of the lips are placed, which have been described (*vide* p. 71, *et seq.* Vol. II.); and between the muscles and the mucous membrane, there are numerous follicular sacs, which are termed the labial glands, and which have their excretory ducts opening into the interior of the mouth.

The lips are supplied with blood by ramusculi from the facial ramuli of the external carotid; and the blood is returned by corresponding venous ramuli, into the internal jugular vein.

Their nervous influence, is derived from the second and third divisions of the fifth pair, and from the facial nerve.

Their absorbents, terminate in the glands situated under the chin.

The *cheeks*—which form the lateral boundaries to the mouth, are composed of skin, a layer of adeps, muscles,

mucous membrane, and the excretory duct of the parotid gland. There is but little to observe with respect to them; the quantity of fat which they contain, gives a general contour to the face; the muscles which particularly enter into their composition, are the buccinatores—by the action of which, they assist in the function of mastication and deglutition; and by pressing the saliva from the ducts of the parotid glands, they perform, in part, the function of taste; and farther, by forcing and directing the air through the mouth, the cheeks become important organs in respiration and voice: but these muscles have been particularly described, as in the above reference.

Some mucous follicles are also placed between the muscles of the cheeks and mucous membrane, which are termed the buccal glands.

The cheeks are supplied with blood, by the facial and internal maxillary ramuli of the external carotid ramus, and the venous branches accompanying the arterial, terminate partly in the internal, and partly in the external jugular vein.

Their absorbents, pass to the glands of the neck, and in an absorbent gland generally situated on the parotid.

The roof of the mouth, or bony palate, as well as the alveolar processes of the two jaws, are covered by a peculiar structure, which is termed the—

*Soft palate, and gums.*—They seem to be a thickening of the common mucous membrane of the mouth, connected by a very dense cellular tissue to the periosteum of the bones to which they are attached. The structure is but little sensible, forming therefore a protection to the osseous parts of the mouth; and being covered by the mucous membrane, it affords a continuous secreting mucous surface.

The gums, which are composed of the same firm compact tissue, which covers the palate, surround the necks of the teeth, and fill the intervals between them, so as to protect all their bony parts which are not covered by enamel.

The soft palate, as well as the gums, receive blood-vessels

and nerves; but their degree of sensibility is very slight in a healthy state, although in disease they become highly painful.

The arterial distribution to the palate and gums, proceeds from the ramifications of the external carotid ramus, and principally from its facial and internal maxillary ramuli.

The nervous distributions, are derived from the second and third divisions of the fifth pair, and from Meckel's ganglion.

The *tonsils*—are placed one on either side of the fauces, between the pillars; they are about the size of an almond, somewhat of that shape, and are placed with their larger extremity upwards, towards the junction of the two pillars of the fauces with the velum pendulum palati; and their smaller extremity points downwards, resting upon the tongue; externally, they are bounded by the superior constrictor of the pharynx; anteriorly, by the constrictor isthmi faucium; and internally, they are directed towards each other.

The tonsil seems to be made up of a number of mucous follicular sacs, united to each other by a firm, dense, cellular tissue, covered by the mucous membrane of the mouth. If a section be made of the tonsil, it presents a honey-comb appearance, from the numerous cells which are laid open, and which are larger nearer their upper than their lower extremities. All these cells are lined by the mucous membrane of the mouth, which enters them by their excretory ducts.

Ramusculi from the lingual, facial, and internal maxillary ramuli, send blood to the tonsils.

The nervous filaments, are supplied by the lingual, and glosso-pharyngeal nerves.

The *tongue*—has already been partly described by the anatomical account of its muscles, as far as refers to it as an organ of deglutition (*vide* p. 91, Vol. II.); but we have now to consider it as the principal organ of taste.

The tongue is placed within the cavity of the mouth, behind the teeth, in front of the epiglottis, above the os hyoides and the pharynx, and below the arch of the palate: it is divided into its body, base, and apex.

The *body*—presents a superior and an inferior surface, and two edges.

The *superior surface,* or *dorsum* of the tongue—presents in its centre a longitudinal furrow, which divides it into symmetrical halves, and which terminates posteriorly in the *foramen cæcum*—an opening of mucous follicles.

The *inferior surface* — is smooth anteriorly, free, and covered by the mucous membrane of the mouth; which membrane posteriorly connects the tongue to the os hyoides, and parts below—producing what is termed the *frænum linguæ.*

The *lateral edges*—are rounded, thicker posteriorly than anteriorly, are fixed behind, by the mucous membrane and muscles, to the lower jaw, and styloid processes of the temporal bones.

The *base*—is the fixed point, is the thickest and broadest part of the tongue, and is united to the os hyoides, epiglottis, and pillars of the fauces, by muscles and mucous membrane.

The *apex*—is free and rounded, and capable of the greatest mobility from the numerous muscles which form the tongue.

The tongue is composed of muscles, which have been described; and also of the mucous membrane of the mouth, which on the tongue bears great resemblance to the common integuments—being covered by a thin epidermis, and furnished with numerous follicles, forming what are termed the *papillæ.* These are divided into three sets.

The *papillæ capitatæ, vel lenticulares—*are usually from nine to fifteen in number, presenting a rounded head, connected with the tongue by a narrow neck. They are placed on the posterior part of the dorsum, and are so arranged as to commence from the foramen cæcum; from thence they pass forwards in two diverging lines, so as to present the appearance of the letter V, with the angle directed backwards.

The *papillæ fungiformes, vel semi-lenticulares*—are much smaller than the former, but much more numerous; they present small round eminences, and are dispersed over the

whole surface of the tongue, but are most developed on the edges; they are separated by slight intervals from each other.

The *papillæ conicæ*—are very numerous, like the preceding, occupy a great part of the superior surface of the tongue, but are most numerous towards its apex, although those placed posteriorly are the larger. These papillæ are supposed to be supplied by, if not formed of, the termination of the gustatory nerve.

The tongue receives nervous influence from the hypoglossal nerve, which supplies its muscles, and imparts to it voluntary motion for the purposes of deglutition, speech, &c.; from the third division of the fifth pair, which is supposed to form the true organ of taste; and from the glossopharyngeal, which is supposed to impart to it functions sympathetic, with the respiratory organs.

### Of the Salivary Glands.

There are three pair of glands, which are constantly pouring their secretion into the cavity of the mouth, and which may be considered, perhaps, equally important to the function of digestion, as to taste; but as no substance can produce any sapid sensation without being dissolved in this fluid, they may be properly enough considered with those organs, which are excited in the function of taste.

The pancreas has sometimes been considered as one of the salivary glands, and there are many circumstances in which they are very similar; as for instance, the disposition of their lobules, the absence of every distinct capsule; the mode of distribution of their blood-vessels, and the strong resemblance of their secretion: but the different situation of the pancreas, and its close connection with the digestive organs, seems to indicate the propriety of describing it, as I have done, with the chylopoietic viscera.

The *salivary glands*—are the parotid, the sub-maxillary, and the sub-lingual, more or less connected with each other, and extending from the temporo-maxillary articulation on

either side to the symphysis of the lower jaw, where they in some measure unite.

The *parotid*—is the largest of the salivary glands; one is placed on either side of the head, reaching from the zygomatic process to the angle of the lower jaw, behind the posterior edge of its ascending plate, between it and the mastoid process of the temporal bone. It is somewhat pyramidal in its form, its sides being flattened, and its largest extremity placed above; it is bounded externally, by the platysma myoides muscle, and the skin of the face; internally, by the temporo-maxillary articulation, ascending plate of the lower jaw, masseter, and pterygoideus internus muscles; and behind, it is opposed to, and by condensed cellular membrane, connected with, the fossa parotidea, and auditory process of the temporal bone, the anterior edge of the sterno-cleido mastoideus, and the posterior belly of the digastricus; and below, with the styloid process of the temporal bone, to which it is firmly united by the deep cervical fascia.

The parotid gland is composed of numerous small lobules, united to each other by a condensed cellular membrane, so as to form small lobes, producing a conglomerate gland, of a greyish yellow color, firm in its texture, and not enclosed in·a distinct capsule. In each of its granules, or lobules, a distinct ramusculus of an artery passes, a ramusculus of a vein commences, and a little excretory duct is given off which soon unites with the duct of another lobule, and this duct again with a third, and so on, until they all form one great duct, which passes out of the anterior edge of the gland to open into the mouth.

·The parotid duct, sometimes termed Stenon's duct, is about two inches and a half to three inches long, and about a line in diameter; it leaves the outer surface of the anterior edge of the gland, and takes its course forwards, across the masseter muscle; having traversed which, it becomes embedded in a considerable quantity of adeps, and gains the buccinator; this it perforates, forming a right angle with

the fibres of that muscle, and opens into the mouth through
its lining mucous membrane, opposite to the second, or
rather between the second and third upper molar teeth.
The parotid duct is composed of two coats; an outer one,
which is peculiarly firm and resisting, possessing almost a
cartilaginous firmness; and an inner, thin delicate continu-
ation of the mucous membrane of the mouth.

The arterial ramifications to the parotid gland, are derived
from the temporal, posterior aural, and facial ramuli of the
external carotid ramus; they are numerous, but very small,
dividing again, and again, before they enter the substance of
the organ.

The venous, correspond with the arterial ramifications, and
terminate in the internal and external jugular veins.

It derives its nervous ramifications from the facial nerve, the
third division of the fifth pair, and from the cervical plexus.

The *sub-maxillary glands.*—One is placed on either side
of the upper part of the neck, immediately below the base of
the lower jaw, in a triangular space, bounded above by the
jaw, and below by the junction of the common tendon of
the anterior and posterior bellies of the digastric muscle, to
the os hyoides.

The exact position of this gland, is very difficult to under-
stand, unless the student first considers how much its rela-
tive situation is altered according to the view which is taken
of it, whether in the erect, or in the recumbent posture.

In the course of its dissection, and consequently in the
recumbent posture of the subject, it would be described as
being placed beneath the skin, platysma myoides, and fascia
of the neck; resting upon the mylo-hyoideus muscle;
bounded externally and posteriorly, by the angle of the jaw,
parotid gland, and posterior belly of the digastric muscle;
and anteriorly, by the hyo-glossus muscle, the hypo-glossal
nerve, and the sub-lingual gland. But when described, as
other parts usually are, in the erect posture of the body, then
the sub-maxillary gland is placed above the platysma my-
oides and skin, below the mylo-hyoideus and sub-lingual

gland; bounded on the outer side, by the angle of the jaw, and pterygoideus internus muscle.; and on the inner, by the hyo-glossus muscle, and hypo-glossal nerve.

The *sub-maxillary gland*—is, like the parotid, composed of numerous little lobes connected by a condensed cellular membrane, and not possessing any distinct envelope.  The junction of all the ducts from each lobule, produce one *excretory duct*, which emanates from the upper surface of the gland, then passes forwards and inwards upon the under surface of the hyo-glossus muscle, between the hypo-glossal and gustatory ramulus of the third division of the fifth pair; and passing between the genio hyo-glossus muscles; and sub-lingual glands, opens into the mouth, on either side of the frænum of the tongue, by a small orifice placed in the centre of a projecting tubercle.  This duct, like that of the parotid, is lined by the mucous membrane of the mouth.

The sub-maxillary gland is furnished with blood by the facial, and lingual ramuli, of the external carotid.

Its venous blood passes into the internal jugular.

Its nervous ramifications, are derived from the third division of the fifth pair, and sub-maxillary ganglion.

The *sub-lingual glands*—are placed, if considered in the erect posture of the body, above the mylo-hyoidei muscles, below the genio hyo-glossi, behind the genio hyoidei, and in front of the sub-maxillary glands.  In form they are somewhat lengthened from before to behind, and flattened laterally; they are organised in a similar manner to the other salivary glands, excepting that they are furnished with several excretory ducts, which in part open by the sides, and part on the frænum of the tongue.

They derive their blood from the facial, and lingual ramuli.

Their nervous influence, is derived from the third division of the fifth pair of nerves, and from the sub-maxillary ganglion.

The chemical analysis, and the properties of the saliva, have been described; *vide* p. 82, Vol III.

### Practical Remarks.

It sometimes happens, that at birth the mouth is imperforate, requiring prompt assistance, by making an horizontal incision so as to divide the two lips; and by the application of some mechanical means, to prevent reunion of the edges of the incision, and at the same time by bringing the cheeks forward to prevent the antagonizing muscles producing too great a distention of the orbicularis oris. The upper lip is also at birth subject to a malformation, termed a hare-lip; generally there is but one fissure, but sometimes more; and these require a surgical operation, to remove the deformity. This disease is sometimes complicated with a fissure extending through the roof of the mouth; if only through the palatine processes of the superior maxillary bone, the fissure will frequently close after the common operation for the hare lip; and in such cases the operation should be performed as early as possible: but if the fissure extends through the palate bones, and soft palate, a further operation is required, to close the cavity. This may be effected by paring the edges of the fissure, and by making two longitudinal incisions, one on either side of the fissure, and at some little distance from it, so as to detach the soft palate from the bone; and then by sutures, to draw the edges of the incised portions together. In the soft palate, the edges alone require paring. In simple hare-lip, the edges of the cleft are to be pared, and the incisions are to be brought in close contact, either by sutures or pins; at the same time bringing the cheeks forwards, to prevent the action of the antagonizing muscles upon the orbicularis oris. The sutures or pins should be allowed to remain three or four days; and when they are removed, the means employed for bringing the cheeks forwards, should still be continued, lest the action of the muscles should tear open the newly-formed cicatrix. If the deformity of the lip is not so great as to prevent the infant sucking, it is better not to perform the operation until after the child be weaned, and has learned to take its food; but if the malformation is so great, as to prevent the child sucking, it must be performed as early as possible.

Cancer of the lip—a disease which occurs almost always in the under lip, may be known by its hardness, wart-like appearance, lancinating pain, and age of the patient—as it rarely occurs before the age of forty. Men are more liable to it than women; and extirpation is the only cure: at the same time, administering alterative medicines, and paying great attention to every means which can be adopted for the improvement of the general health. After the disease has been removed, the edges of the wound are to be brought together, in the same manner as in hare-lip.

The tongue is not unfrequently the subject of disease, and ulcer is that of the most frequent occurrence, being often produced by the rough edge of a tooth; if this be the cause, filing the tooth, or extracting it, will prove its infallible remedy. Ulcers in the tongue, sometimes are concomitant with a deranged state of the digestive organs, producing little aphthous sores on the mucous membrane of the tongue and lips. In these cases, the ulcers should be touched with nitric acid, and blue pill, with neutral salts and bitters, used as constitutional remedies.

The tongue is also liable to malignant diseases, and cancerous ulceration is not very unfrequent. In this situation, as in other parts of the body, extirpation of the diseased part is the only hope; and when it can be effected, is to be performed in the following manner:—a needle is to be passed through the centre of the tongue, opposite to the disease, armed with two ligatures, and by this means the tongue is readily held by an assistant, which cannot in any other way be commanded; one ligature is then to be tied tightly behind, and one in front of the ulcer, including between the ligatures a sufficient portion of healthy parts, as to allow of the complete extirpation of the disease; these ligatures preclude the possibility of any alarming hæmorrhage. The exposed surface should either be touched with nitric acid or actual cautery, with the hope of inducing a new action; and the constitution should be affected by alterative, and tonic medicines. As far as my experience goes, however, this disease soon returns in the absorbent glands under the lower jaw; and five months is the longest period I have known any patient survive the extirpation of a cancerous ulcer from the tongue. The frænum of the tongue may require to be cut, for the purpose of liberating the organ when the frænum is too short, either to allow the tongue to be brought out of the mouth, or to be raised up to the palate. In performing this operation, the scissors should be directed downwards, so as to avoid the ranine artery.

The tonsils are sometimes inflamed, so much so as to interfere with deglutition and respiration. Relief may immediately be obtained, by scarifying the tonsils, and by the use of restringent lotions, and alterative medicines. The inflammation, however, sometimes goes on to form abscess, which not only produces mechanical obstruction to deglutition, but also such constitutional derangement as occurs in the formation of matter in other parts of the body. The matter should be immediately evacuated, by passing either the point of a lancet or a phymosis knife into the tonsil, directing it backwards, downwards, and inwards, so as to avoid injury to the internal carotid ramus, which is behind it and to its outer side. The extirpation of a part of the tonsil, is sometimes required, in consequence of chronic inflammation, producing

such a permanent enlargement, as to interfere with deglutition and breathing.

This operation is best performed by the application of a ligature, which is applied by means of what is called a tonsil needle, and being tied tightly around the diseased part, it is to be twisted tighter every day until the included portion of the tonsil sloughs off. The tonsil needle may either be passed through the nose, or mouth, as may be found most convenient to the operator.

The uvula is not unfrequently elongated; astringent gargles are usually sufficient to effect its contraction; but it sometimes will not yield to this treatment, and requires excision; and the superfluous portion may be removed with scissors, without any fear of ill effects from hæmorrhage.

The diseases of the gums and teeth, I have intentionally omitted, as my friend and colleague Mr. Thomas Bell, not only lectures most ably, but has written a *most excellent* work upon the subject.

From ulcer or wound in the cheek, it sometimes happens, that the parotid duct, or the parotid gland itself, is injured, so that the saliva is constantly pouring upon the face, and the wound thereby prevented from being healed, soon puts on a fistulous character. If the accident be a wound of the duct,—either from any accidental cause, or perhaps from surgical operation, as removing a small tumour from the face,—the aperture should be immediately closed; and every attempt made to unite the outer wound, by a just adaptation of the parts, and desiring the patient not to masticate for a few days, so that the part may not only be kept in a perfect state of rest, but that also the salivary appa-ratus may not be stimulated to secretion. If the wound has been open for some time, these means will prove ineffectual, and an operation is usually necessary to produce a cure. This operation is performed in the following manner :—a needle armed with a thread is passed through the opening in the duct, directly into the mouth, and a knot being tied at the farther end of the thread, the ligature is drawn tight so as to keep a constant pressure upon the knot, and induce its ulceration into the mouth; by which means a passage is established, and the saliva no longer passes through the outer wound, which soon heals. Desault recommends as a cure for salivary fistula, such a degree of pressure upon the salivary gland, as to induce its absorption; hence, no saliva being secreted, the fistula heals, and it is found that no ill effects are produced by the diminution of the quantity of saliva secreted. I have myself, in removing a small diseased absorbent gland, wounded the parotid gland, and a quantity of saliva was immediately poured out. Considerable difficulty occurred in the reparation of this wound; but after caustic, actual cautery, and other means had failed,

sprinkling the red oxyd of mercury two or three times a day upon the wound, ultimately succeeded in curing it.

The sub-maxillary and the sub-lingual ducts, are sometimes rendered impervious, either from the thickening of the lining mucous membrane, or from minute calculi obstructing them; the result of which is, great distention of their salivary ducts, producing a considerable tumour underneath the tongue : this disease is termed—

*Ranula*—and may be known at once by its fluctuating feel, and by its semi-transparency. It sometimes produces great difficulty of breathing, from pressing the tongue backwards so as to close the glottis. The late Mr. Cline heard a person fall in his anti-room, and running in to see what was the matter, he found a gentleman lying on the floor, with his countenance livid, and apparently struggling in the last agonies of death. Mr. Cline immediately passed his finger into the mouth, to observe what might be the cause of this asphyxia, and there discovered a large ranula, into which he directly thrust his lancet, let out the saliva, and the patient was immediately restored by the prompt application of Mr. Cline's surgical knowledge.

When the disease is recent, the contents of the tumour have perfect resemblance to the white of an egg : but they soon become more viscid, and of a darker color. Whether the tumour affects deglutition and respiration, or not, it should be laid open, as its pressure is sure to cause injury to the lower jaw. They produce but little or no pain, and are generally cured by laying the tumour open, and cutting out a portion of the sac : some surgeons further recommend a stimulating application to the inner surface of the sac, to secure adhesive inflammation. If the ranula be very small, and a small calculus the cause of the obstruction of the duct, the removal of the calculus will usually be found sufficient, without any further operation.

## Physiology of Taste.

The sense of taste, informs us of the flavor or sapid qualities of bodies dissolved in saliva. Certain bodies, however, that are soluble, are yet destitute of tase; while others, apparently insoluble, have yet a distinct flavour. Hence it has been conjectured, that the chemical properties, and their peculiar connection with the animal economy, may therefore contribute to the sense of taste.

Such bodies as produce an agreeable flavour, are generally useful and nutritious; while those which are pernicious, occasion a disagreeable sensation in the mouth.

Bodies are said to be bitter or sweet, sour, acid or acrid; but like the classification of odours, no satisfactory arrangement has yet been made of sapid bodies.

The tongue, is the principal organ of taste; but it is evident, that the lips, internal surface of the cheeks, palate, pharynx, œsophagus, and even the stomach itself, are capable of receiving impressions from the contact of sapid bodies, which contribute to the perfection of this sense —the actual seat of which has so long been a matter of controversy amongst physiologists. The experiments of Guyot, detailed in the *Bibliotheque Universelle*, appear, however, to set this matter at rest. The tongue was enclosed in a case of soft parchment, which only extended from the tip to about the middle; sapid bodies then introduced, gave no taste:—proving, that the anterior extremity of the tongue was the essential organ of taste. The tongue was next covered entirely, when common bodies being introduced gave no taste; but extract of aloes, and other bodies very highly sapid, gave a slight taste at the posterior part of the tongue, corresponding to the velum palatum. No other sensation than that of touching was excited on the application of extract of aloes to the palate, roof of the mouth, or cheeks. It is the anterior and upper part of the velum palatum which possesses the sense, in a space, however, small and undefined in its limits.

It was further observed, that when the tongue was covered with parchment, and a hole being left in the middle of its posterior surface, that on the application of sapid bodies to this exposed portion, the sense of taste was not produced until the sapid body was dissolved in saliva, and gained access to the tip of the tongue. And Guyot found, that only certain parts, namely, within a space of about one or two lines at the sides, three or four at the tip, and within a curved space at the back, were the only seats of the organ of taste.

The saliva poured into the mouth from the salivary glands, possesses a peculiar power as a solvent; and in the act of tasting, it is evident that the operation consists in applying the tongue in such a manner as to expose its papillæ to the sapid substance mixed with the saliva. Mere contact, however, may be sufficient for fluid, or gasseous bodies; but solid bodies appear to require actual solution, before their flavour can be tasted.

The arrangement of the papillæ is so made, that those which distinguish flavour are protected, and as it were separated from those which secrete the mucus, lubricating the mouth, and fauces, contributing to the act of swallowing.

The papillæ conicæ—are disposed in two rows, wider at the tip and back part of the tongue, than at the sides, and are probably those destined particularly to the sense of taste

The nerves which supply the tongue, are derived from several sources; thus we have the inferior, and a few ramuli from the superior maxillary rami, filaments also from the spheno-palatine ganglion, the naso-palatine of Meckel, the lingual, and the glosso-pharyngeal nerves.

The lingual, or gustatory branch of the fifth pair, has been traced to the villi, and papillæ conicæ, and has therefore been considered as the principal nerve of the sense of taste ; but other nerves may also contribute, although they cannot be traced distinctly.

Majendie asserts, that on the division of the lingual gustatory nerve, the tongue continues the power of motion, but loses the sense of flavour; but the palate, gums, and internal surface of the cheeks, preserve their aptitude for the exercise of taste : but if the trunk of the fifth pair be divided in the cranium, then the property of recognising flavours is completely lost. The same occurs in diseases affecting the fifth pair.

When sapid bodies are brought into contact with the mucous surface of the tongue, such as vinegar, mineral acids, alkalies, and many others, the color of the membrane has been observed to change—becoming sometimes white, at others yellow : from whence it has been conjectured, that some chemical change has been effected, and that the durability of an impression depends upon their changes. For instance :—acrid bodies leave an after-impression in the pharynx; acids, on the lips, and teeth ; peppermint, through the mouth and pharynx. These impressions obtain a wonderful degree of delicacy and accuracy, by exercise and habit of the parts, as may be evinced by those who have exercised it in distinguishing the flavour of wines. In old persons, this sense becomes weak, and requires stimulating things to excite it: it appears, also, that young infants do not fully acquire the sense of taste, until some time after they are born; they however possess it at birth, as may be seen by placing a bitter or saline substance on the lips.

Taste presides over the choice of food, and enables us to distinguish between wholesome and noxious substances; and when exercised with agreeable food, is a source of considerable pleasure, but which, if too much indulged, will form an epicure, whose wants are an evident abuse of this sense.

FINIS.

Fig.1. Fig.2. Fig.4.

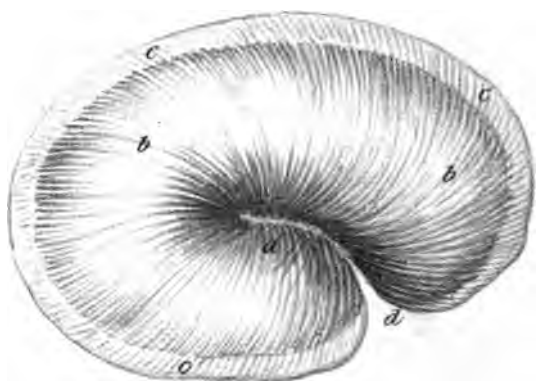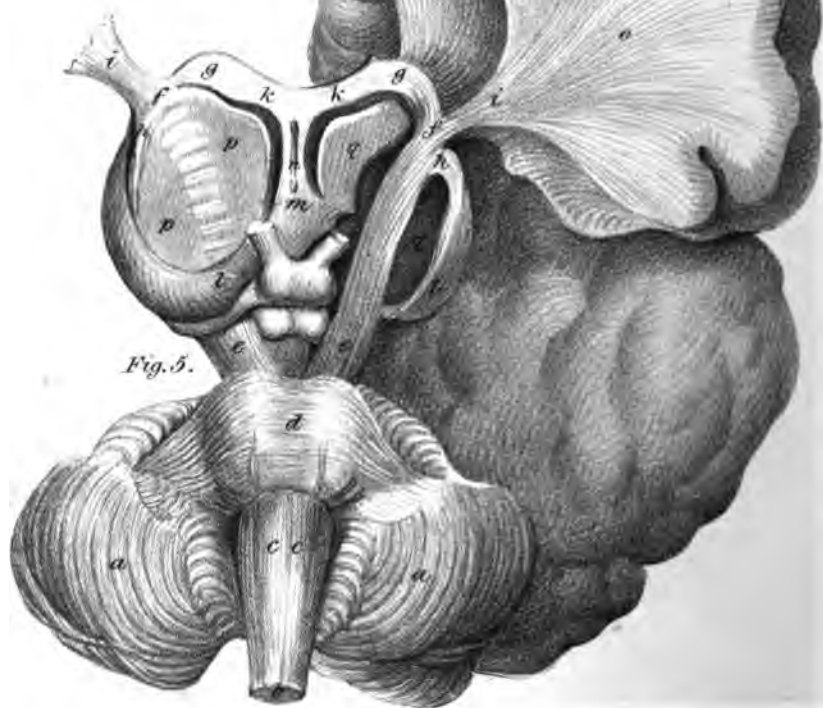Fig.3

Fig.5.

Pl.1

# EXPLANATION OF THE PLATES.

## PLATE I.

### *Fig.* 1.

The earliest appearance of the brain and spinal marrow twice the
natural size. From a fœtus of seven weeks. Viewed anteriorly.

a. a.   Spinal marrow.
  b.   Orifice of the canal of the spinal marrow.
  c.   Enlargement of the spinal marrow.
d. d.   Cerebellum, extended like a bridge over the fourth ventricle.
e. e.   The tubercula quadrigemina, separated by a middle line.

### *Fig.* 2.

Side-view of Fig. 1.

a.   Spinal marrow.
b.   Enlargement of the spinal marrow, with its inflection forwards.
c.   Cerebellum.
d.   Mass of the tubercula quadrigemina.
e.   Optic chambers.
f.   Membranous hemispheres of the brain.
g.   Protuberance analogous to the corpus striatum.

### *Fig* 3.

a. a. a. a.   Two principal cords of the spinal marrow, separated to
         shew the continuity of the canal with the fourth ven-
         tricle.
    b. b.   Peduncles of the cerebellum inclined towards each other.

*Fig.* 4.

Radiation of the fibres as they proceed from the crus cerebri, as
seen in a fœtal brain of six months.

  *a.* Point of radiation.
  *b. b.*. Radiating fibres.
 *c. c. c.* Softer fibres exterior to them.
   *d.* Fissure of Sylvius.

*Fig.* 5.

View of the under surface of the brain, according to the mode of
dissection adopted by Dr. Foville.

*a. a.*   The cerebellum.
 *b.*   The medulla oblongata.
*c. c.*   The corpora pyramidalia.
 *d.*   The pons varolii.
*e. e.*   Continuation of the corpora pyramidalia through the pons
    varolii to the crura cerebri.
*f. f.*   The point at which the corpora pyramidalia divide into
    three layers, or plates, just at the outer side of the
    corpora striata.
 *g.*   The ascending plate.
 *h.*   The descending plate.
 *i.*   The external plate.
*k. k.*   The ascending plates, one from either side uniting to form
    the corpus callosum.
*l. l.*   The descending plates, uniting in the mesian line to form
    the septum lucidum, *m.*
 *n.*   The fifth ventricle between the two layers of the septum
    lucidum.
*o. o.*   The fibres of the external plate diverging to form the
    hemispheres of the cerebrum.
*p. p.*   Section of the corpus striatum of the right side, shewing
    the fibres of the corpus pyramidale passing through it
    to the point at *f.*
*q. q.*   Section of the corpus striatum of the left side, the continu-
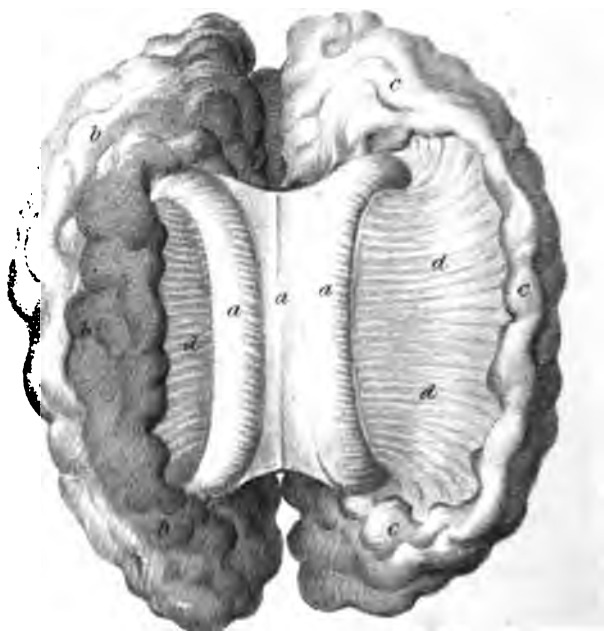    ation of the corpus pyramidale being left entire.
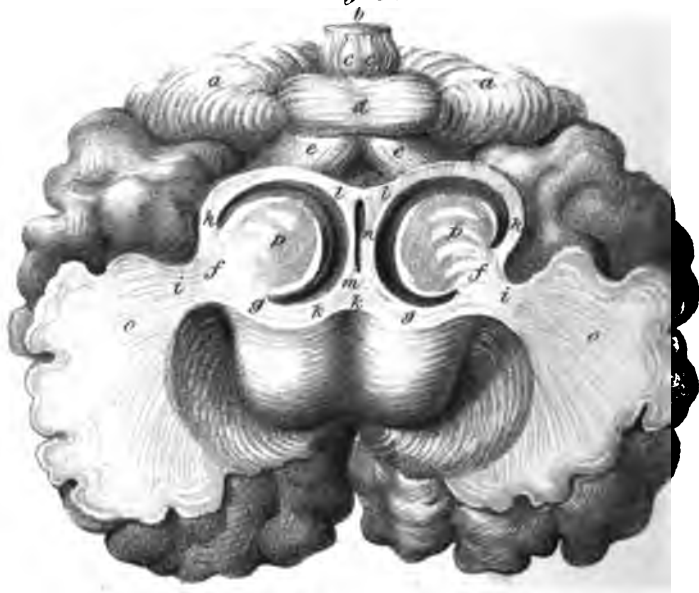
Pl 2

Fig.1.



Fig. 2 .

# PLATE II.

## Fig. 1.

The upper surface of the brain, the hemispheres being separated.

*a. a. a.*    The corpus callosum, having the raphe in its centre.
*b. b. b.*    The left hemisphere, but slightly separated.
*c. c. c.*    The right hemisphere, separated to its fullest extent.
*d. d. d.*    The diverging fibres of the external plate.

## Fig. 2.

Front view of a transverse section of the brain, opposite to the coronal suture. The under surface being shortened, and placed uppermost, to exemplify more perfectly the three plates of the corpora pyramidalia.

The references the same as to Fig. 5. Plate I.
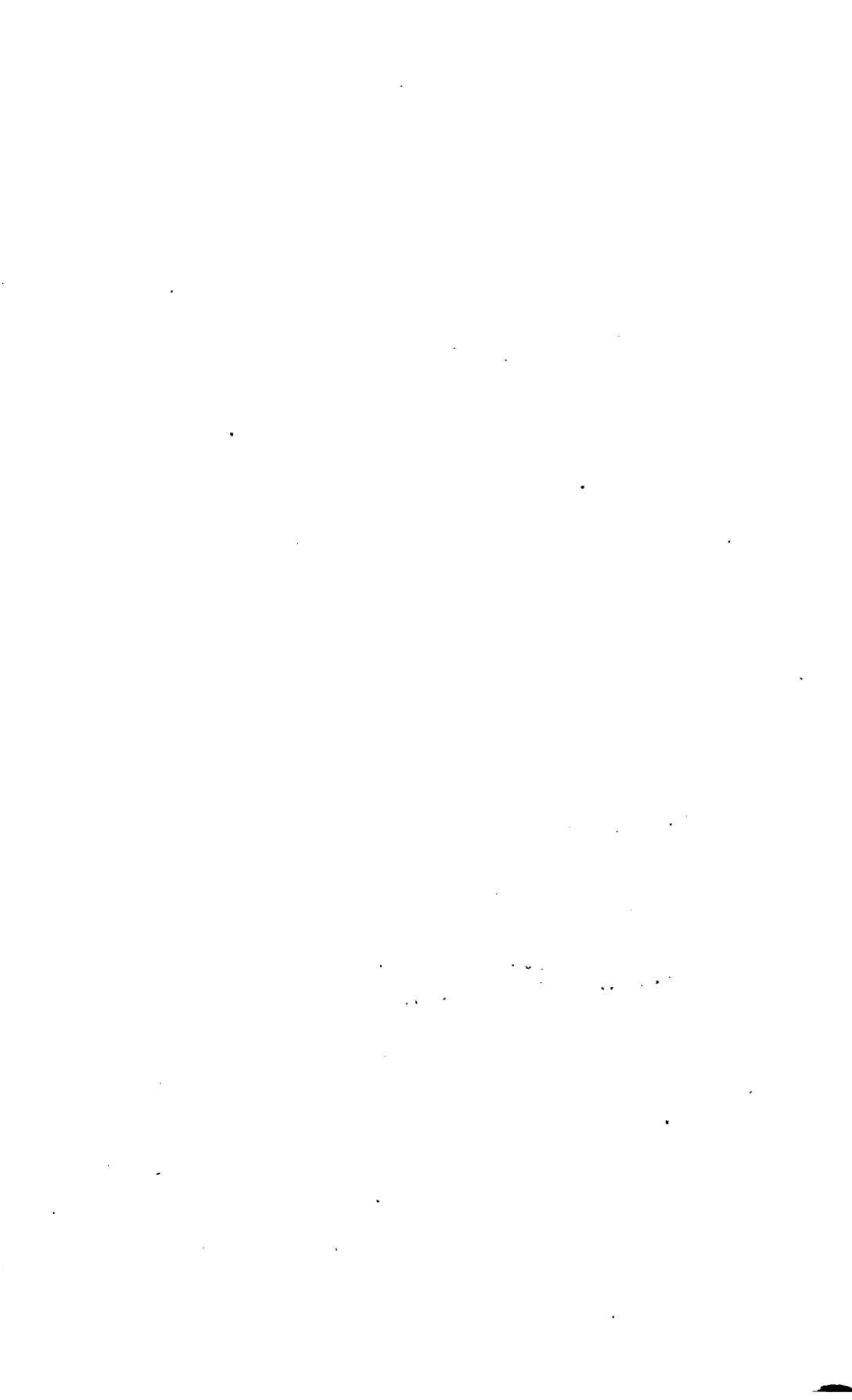
Fig 1.
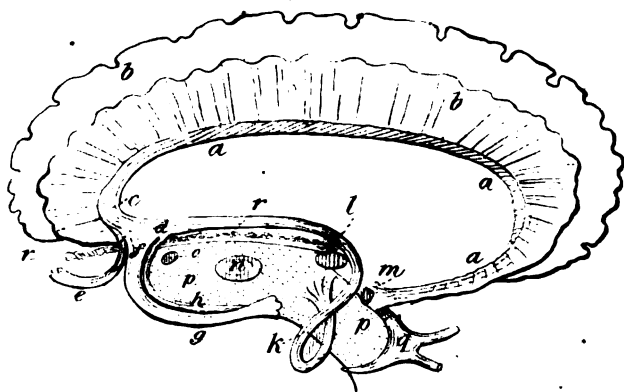


Fig. 2.
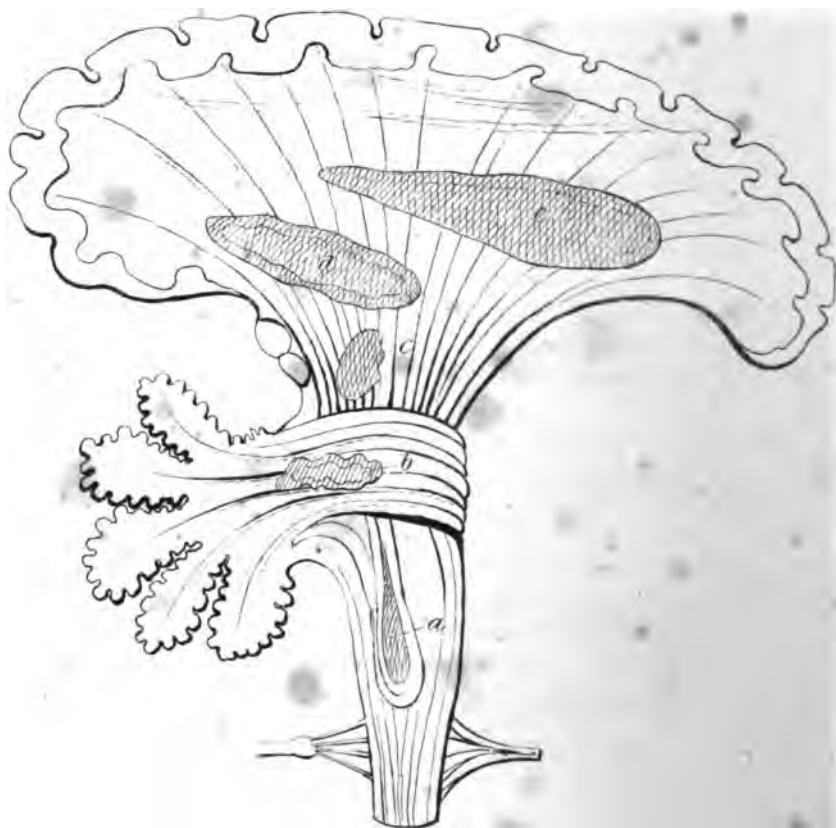
# PLATE III.

## *Fig.* 1.

Diagram of a side-view of the same dissection, produced by a vertical section from the centre of the corpus callosum to the base of the brain.

*a. a. a.* Corpus callosum.
   *b. b.* Hemisphere.
     *c.* Point at which the corpus callosum unites with the fornix.
     *d.* The fornix.
     *e.* Hippocampus minor.
     *f.* Hippocampus major.
     *g.* Pes hippocampus.
     *h.* Tænia hippocampus, or posterior crus of the fornix.
     *i.* Anterior crus of the fornix.
     *k.* The processus mammillaris.
     *l.* Foramen of Monro.
     *m.* Anterior commissure.
     *n.* Middle commissure.
     *o.* Posterior commissure.
   *p. p.* Thalamus nervi optici.
     *q.* Optic nerves.
   *r. r.* Plexus choroides.

## *Fig.* 2.

Diagram, in which the situation of the ganglia of Drs. Gall and Spurzheim are seen.

*a.* Grey matter in the corpus olivare.
*b.* Grey matter in the pons varolii.
*c.* Grey matter in the crus cerebelli.
*d.* Grey matter in the thalami nervi optici.
*e.* Corpus striatum.

Fig 1.

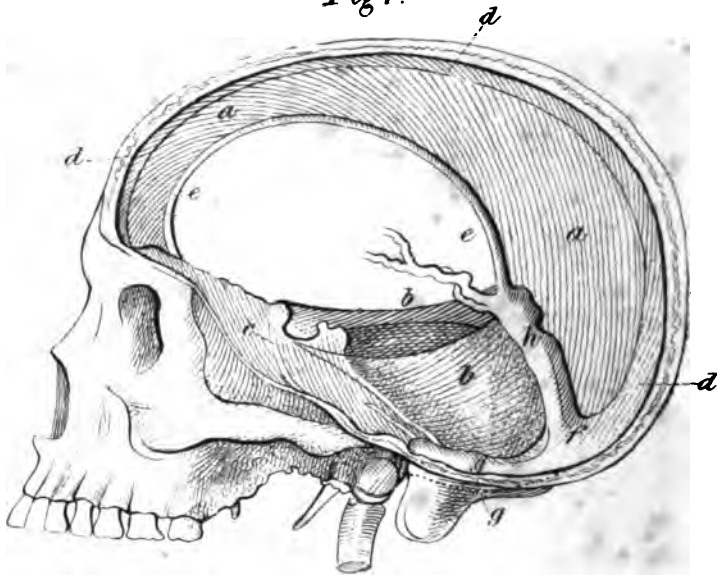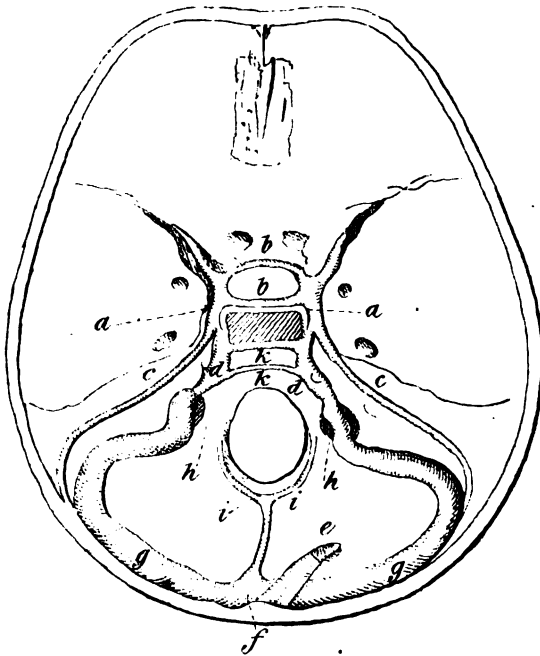Fig 2.

# PLATE IV.

## *Fig.* 1.
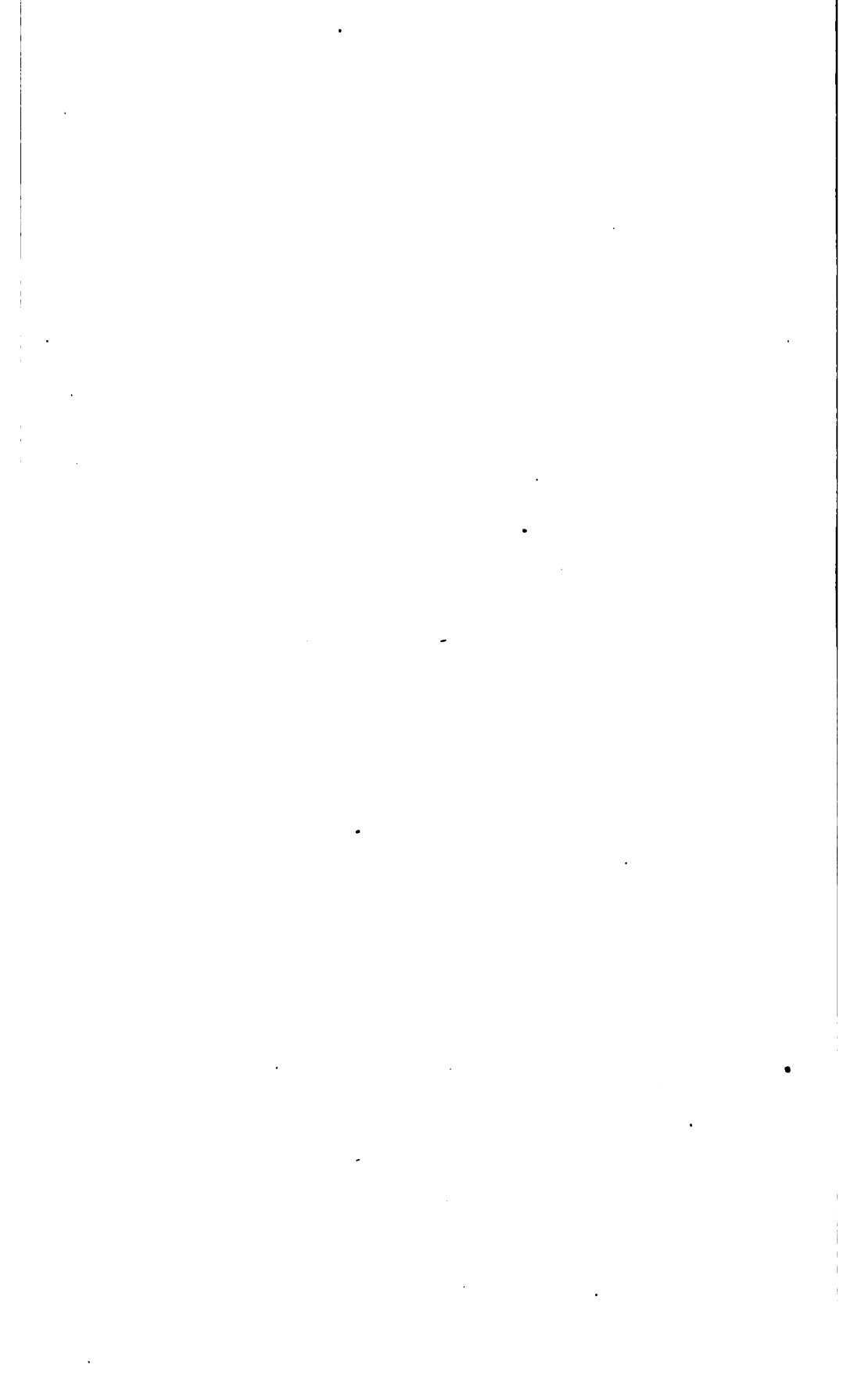
The processes and sinuses of the dura mater.

*a. a.*   The falx major.
*b. b.*   The tentorium.
*c.*   Sphenoidal fold, left side.
*d. d. d.*   Superior longitudinal sinus.
*e. e.*   Inferior longitudinal sinus.
*f.*   Torcular herophili.
*g.*   Lateral sinus.
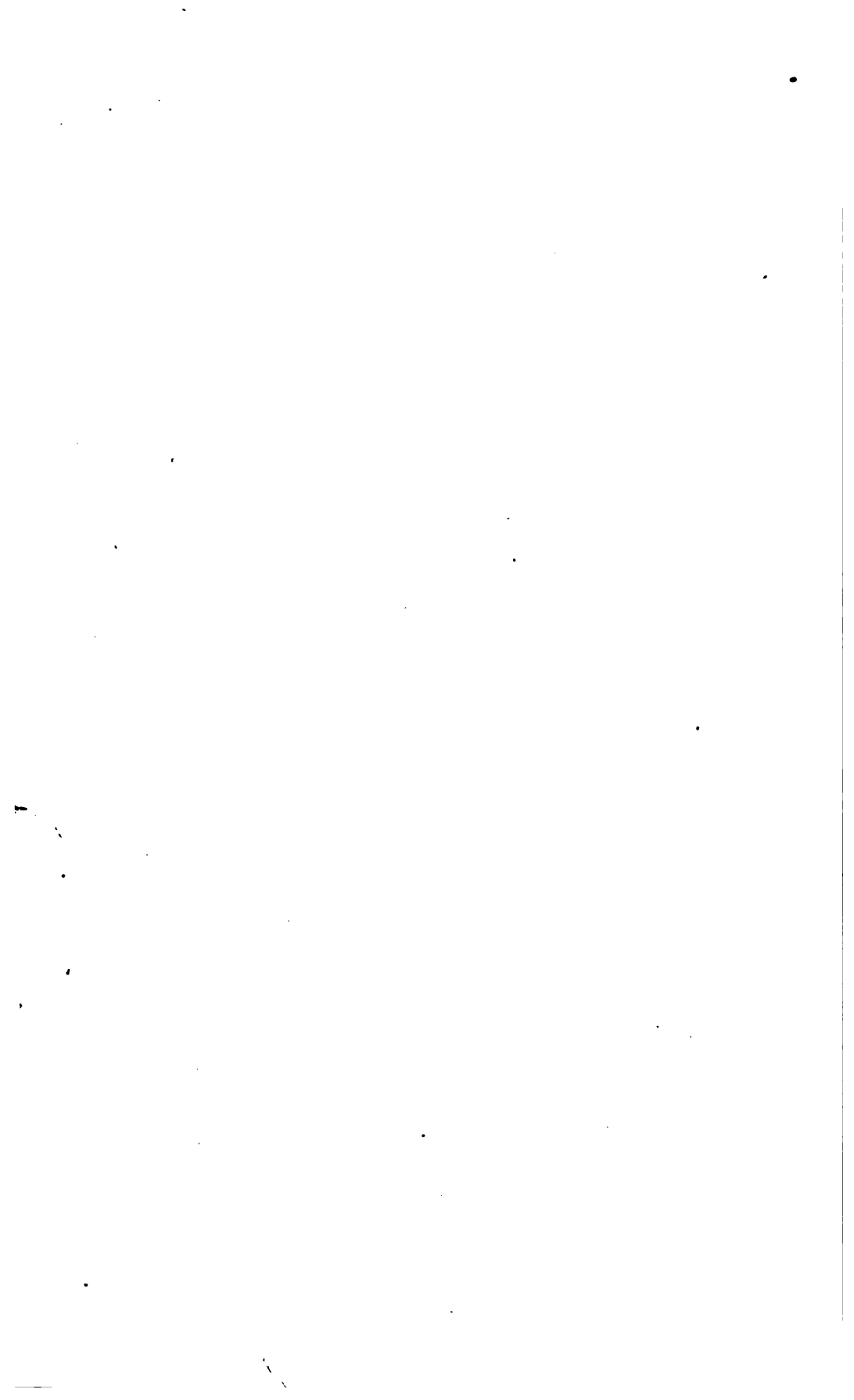*h.*   Straight sinus.
*i.*   Vena magna Galeni.

## *Fig.* 2.

Sinuses in the internal part of the basis of the cranium.

*a. a.*   Cavernous sinuses.
*b. b.*   Circular sinuses.
*c. c.*   Superior petrosal sinuses.
*d. d.*   Inferior petrosal sinuses.
*e.*   Superior longitudinal sinus.
*f.*   Torcular herophili.
*g. g.*   Lateral sinuses.
*h. h.*   Foramina lacera basis cranii.
*i. i.*   Posterior occipital sinuses.
*k. k.*   Anterior occipital sinuses.